U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-280 975

Regulations and Resource File of Continuous Monitoring Information

Entropy Environmentalists, Inc, Research Triangle Park, N C

Prepared for

Environmental Protection Agency, Washington, D C

Feb 78

PB 280 975

REGULATIONS AND RESOURCE FILE OF CONTINUOUS EMISSION MONITORING INFORMATION

Interim Report

Stationary Source Enforcement Series

EPA-340/1-78-002
February 1978

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF ENFORCEMENT
OFFICE OF GENERAL ENFORCEMENT
WASHINGTON, D.C. 20460

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO.
340/1-78-002

2.

3. RECIPIENT'S ACCESSION NO.
PB280975

4. TITLE AND SUBTITLE
Regulations and Resource File of Continuous
Monitoring Information

5. REPORT DATE
February, 1978

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
William J. Pate

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Entropy Environmentalists, Inc.
P. O. Box 12291
Research Triangle Park, N. C. 27709

10. PROGRAM ELEMENT NO.

11. CONTRACT/GRANT NO.
68-01-4148

12. SPONSORING AGENCY NAME AND ADDRESS
U. S. Environmental Protection Agency
Office of Enforcement
Office of General Enforcement
Washington, D. C. 20460

13. TYPE OF REPORT AND PERIOD COVERED
Interim

14. SPONSORING AGENCY CODE
122/23

15. SUPPLEMENTARY NOTES

16. ABSTRACT

The Environmental Protection Agency has promulgated revisions to 40 CFR Part 60, New Source Performance Standards, and 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants that require specified categories of stationary sources to continuously monitor emissions. The EPA has also required States to revise their SIP's to include continuous emission monitoring regulations.

This report is a compilation of the following continuous emission monitoring information: EPA organizations and personnel involved with continuous emission monitoring; continuous emission monitoring regulations; vendors of continuous monitoring equipment; and a bibliography of continuous monitoring literature.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Continuous Emission Monitoring Regulations	Continuous Emission Monitoring	13B
New Source Performance Standards		14D

18. DISTRIBUTION STATEMENT
Release Unlimited

19. SECURITY CLASS *(This Report)*
Unclassified

20. SECURITY CLASS *(This page)*
Unclassified

21. NO. OF PAGES
193

22. PRICE
A09 - A01

EPA Form 2220-1 (9-73)

ATTENTION

PORTIONS OF THIS REPORT ARE NOT LEGIBLE.
HOWEVER, IT IS THE BEST REPRODUCTION
AVAILABLE FROM THE COPY SENT TO NTIS.

EPA-340/1-78-002

REGULATIONS AND RESOURCE FILE OF CONTINUOUS MONITORING INFORMATION

Interim Report

by

William J. Pate
Entropy Environmentalists, Inc.
P. O. Box 12291
Research Triangle Park, N. C. 27709

Contract No. 68-01-4148

EPA Project Officer: Louis R. Paley

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement
Office of General Enforcement
Washington, D. C. 20460

February 1978

ia

TABLE OF CONTENTS

I. INTRODUCTION I-1

II. EPA PERSONNEL AND ORGANIZATIONS INVOLVED WITH CONTINUOUS MONITORING

- A. Continuous Monitoring Subject Index II-1
- B. Regional Office Continuous Monitoring Contacts II-3
- C. Organization Function Statements II-5

III. MONITORING REGULATIONS

- A. Detailed Table of Contents for Section III Section III
- B. Introduction III-1
- C. Excerpts of NSPS regulations III-5
- D. Excerpts of SIP regulations III-107
- E. Excerpts of NESHAP regulations III-117
- F. Summary tables of monitoring regulations III-137

IV. VENDORS OF MONITORING EQUIPMENT

- A. Vendors IV-1
- B. Addresses IV-4

V. BIBLIOGRAPHY

- A. Bibliography Index V-1
- B. Bibliography V-2
- C. Availability of EPA publications V-7

INTRODUCTION

On October 6, 1975, EPA promulgated regulations that require specified categories of new and modified stationary sources to continuously monitor their emissions and/or processes. Also on October 6, 1975, EPA promulgated a regulation that requires States to revise their State Implementation Plans to include continuous monitoring requirements for existing sources. As a result of these regulations, much information related to continuous monitoring has developed. This resource file is a compilation and organization of continuous monitoring information. It contains function statements for EPA organizations that work in continuous monitoring, identification of EPA personnel that work in continuous monitoring, identification of vendors of continuous monitoring equipment, regulatory information related to continuous monitoring, and a bibliography of continuous monitoring publications.

The continuous monitoring information was collected by talking with EPA personnel, reading continuous monitoring publications, carefully studying the regulations, and by talking with vendors of continuous monitoring equipment. Janet Zieleniewski, of PEDCo Environmental Specialists, was responsible for compiling updated continuous monitoring regulations.

EPA PERSONNEL AND ORGANIZATIONS
INVOLVED WITH CONTINUOUS MONITORING

Page No.

1. Continuous Monitoring Subject Index II-1

2. Regional Office Continuous Monitoring Contacts II-3

3. Organization Function Statements II-5

Continuous Monitoring Subject Index

Subject	Person-Division	Phone #
Federal Register Regulations		
Development	Larry Jones - ESED	629-5421
	Gene Smith - ESED	629-5421
Enforcement	Lou Paley - DSSE	755-8137
Interpretation	Rich Biondi - DSSE	755-2564
Standards		
Development	Larry Jones - ESED	629-5421
Field Evaluation	George Walsh - ESED	629-5423
	Ed McCarley - ESED	629-5245
Monitoring Methods		
Applications, Development & Evaluation	Roger Shigehara - ESED	629-5216
Enforcement Applications	Lou Paley - DSSE	755-8137
Research, Development, & Evaluations	John Nader - ESRL	629-3085
Enforcement		
General Policy	John Rasnic - DSSE	755-2564
Training Materials & Manuals	Lou Paley - DSSE	755-8137
	Kirk Foster - DSSE	629-4571
Determinations of Applicability	Rich Biondi - DSSE	755-2564
Quality Assurance		
Implementation of EPA Quality Assurance	John Clements - EMSL	629-2196
Traceability Protocol	Darryl Von Lehmden - EMSL	629-2415
Monitoring Instrumentation Performance Audits	Tom Logan - EMSL	629-2580
Continuous Monitoring Research		
Transmissometry	Bill Conner - ESRL	629-3173
Gas Monitors	Jim Homolya - ESRL	629-3085
	Ro Rollins - ESRL	629-3171
	Jim Cheney - ESRL	629-3172
Transport Systems (extractive analyzers)	Jim Homolya -ESRL	629-3085

Subject	Person-Division	Phone #
Remote Gas Sensing	Bill Herget - ESRL	629-3184
Remote Particulate Sensing	Bill Conner - ESRL	629-3173
	Jim Vincent - NEIC	239-4656
Continuous Process Monitors		
Use of	James Dorsey - IERL	629-2557
	Bill Kuykendall - IERL	629-2557
State Implementation Plans		
Revisions	Gary Rust - CPDD	629-5365
	Johnnie Pearson - CPDD	629-5497

REGIONAL OFFICE CONTINUOUS MONITORING CONTACTS

Region I

PROGRAM AREA	PERSON	DIVISION	PHONE NUMBER
SIP	Thomas Devine	A & HM	223-6883
	Don White	A & HM	223-5630
NSPS	Linda Murphy	A & HM	223-4448
NESHAP	John Coureier	A & HM	223-4448
Technical	Wally Woo	S & A	(617) 861-6700 (commercial)

Region II

SIP	Gerald Soffian	Env. Programs	264-2518
NSPS	F. W. Giaccone	Facilities Tech.	264-9627
	Dennis Santella	Facilities Tech.	264-9628
NESHAP	Marcus Kantz	Facilities Tech.	264-9538
Technical	J. A. Spatola	S & A	340-6690
	F. E. Giaccone	Facilities Tech.	264-9627

Region III

SIP	Israel Milner	A & HM	597-8174
NSPS	Leland Marshall	Enforcement	
	L. Felleisen	A & HM	597-8183
NESHAP	Abraham Ferdas	Enforcement	597-9893
Technical	Robert Kramer	S & A	597-9843

Region IV

SIP	Tommie Gibbs	A & HM	257-4552
NSPS	Tommie Gibbs	A & HM	257-4552
	James Wilburn	Enforcement	257-4298
NESHAP	Brian Beals	Enforcement	257-4552
Technical	Jerome Rom	A & HM	257-2786

Region V

SIP	Sue Karacki	A & HM	353-2205
NSPS	Bruce Varner	Enforcement	353-2086
	Eric Cohen	Enforcement	353-2090
NESHAP	Rosemary Karas	Enforcement	353-2090
Technical	Ed Zylstra	S & A	353-2303
	L. Torrez	S & A	353-2303

Region VI

SIP	Jack Divita	A & HM	749-3837
NSPS	Carl Edlen	Enforcement	749-7675
NESHAP	Gary Bernath	Enforcement	749-7675
Technical	Phil Schwindt	S & A	749-7126

Region VII

SIP	Dewayne Durst	A & HM	758-3791
NSPS	Peter Culver	Enforcement	374-2476
NESHAP	P. K. Monahan	Enforcement	758-5823
	Peter Culver	Enforcement	374-2576
Technical	W. A. Spratlin	S & A	758-4285

Region VIII

SIP	Robert DeSpain	A & HM	327-3711
NSPS &	Christine Phillips	Enforcement	327-2361
NESHAP	Norman Huey	A & HM	327-3763
Technical	John Floyd	S & A	327-4261

Region IX

SIP	Allyn Davis	A & HM	556-7882
NSPS	Terry Stumph	Enforcement	556-6150
NESHAP	William Pierce	Enforcement	556-3450
	Chuck Seeley	Enforcement	556-0970
Technical	Carl Kohnert	S & A	556-8752

Region X

SIP	Clark Gaulding	A & HM	399-1230
NSPS	Charles Findley	A & HM	399-1125
NESHAP	Charles Findley	A & HM	399-1125
Technical	Paul Boys	S & A	399-1106

ORGANIZATION FUNCTION STATEMENTS

I. The Division of Stationary Source Enforcement (DSSE)

The Division of Stationary Source Enforcement provides for the enforcement of continuous emission monitoring regulations by developing and distributing enforcement and regulatory guidelines, developing policies and procedures for surveillance programs, publishing training materials, organizing workshops on monitoring related areas, and providing guidance and assistance to regional offices and State agencies.

DSSE increases the utility and effectiveness of continuous emission monitoring programs by assuring the enforceability of NSPS and NESHAP regulations, suggesting the use of continuous monitors for additional source categories, developing improved procedures for data handling and reporting, interpreting the regulations, and providing regional offices with determinations of applicability.

II. The Control Programs Development Division (CPDD)

The Control Programs Development Division is responsible for reviewing, evaluating, and reporting on the implementation of air program activities by regional, state, and local agencies; managing training and technical information services; reviewing SIP continuous monitoring revisions; and promulgating national SIP revisions when state revisions are deficient.

III. The Emission Standards and Engineering Division (ESED)

The Emission Standards and Engineering Division is responsible for developing and revising the NSPS and NESHAP continuous monitoring provisions as needed; specifying continuous monitoring requirements for additional NSPS and NESHAP source categories; developing, evaluating and improving continuous monitoring methods and equipment; conducting continuous monitoring in support of standard development; compiling and maintaining emission test data; and providing guidance to regional offices on matters pertaining to continuous emission monitoring.

IV. The Environmental Monitoring and Support Laboratory, Quality Assurance Branch (EMSL, QAB)

The Environmental Monitoring and Support Laboratory, Quality Assurance Branch is responsible for developing and maintaining quality assurance programs for the EPA. EMSL, QAB is also responsible for providing monitoring methods development, performing continuous monitoring equipment performance audits, and establishing protocol for traceability of calibration gases used with continuous emission monitors.

V. The Industrial Environmental Research Laboratory (IERL)

The Industrial Environmental Research Laboratory develops, evaluates, and applies continuous emission and process monitoring for technology studies of industrial and energy processes.

VI. The Environmental Science Research Laboratory, Stationary Source Research Branch (ESRL, SSRB)

The Environmental Science Research Laboratory, Stationary Source Research Branch conducts research and development studies on continuous monitoring methods and instrumentation for measuring opacity and gaseous and particulate pollutants; develops new measurement methods and instrumentation; evaluates prototype and unproven continuous monitoring instruments; and conducts studies to determine the correlation between opacity measurements and particulate emissions.

TABLE OF CONTENTS - SECTION III

INTRODUCTION III-1

NSPS EXCERPTS

- Subparts A-AA III-5
- Reference Methods 1-4, 6-9 III-29
- Appendix B - PS 1,2, &3 III-60
- Excerpts of Preambles III-72
- Proposed monitoring regulations
  - Subpart D III-80
  - Subpart J III-84
  - Subpart N III-90
  - Subpart BB III-94
  - Subpart HH III-102

SIP MONITORING REQUIREMENTS III-107

NESHAP EXCERPTS

- Subpart F Vinyl Chloride III-118
- Method 106 Determination of Vinyl Chloride from stationary sources III-124
- Excerpts of Preambles III-126

SUMMARY TABLES OF MONITORING REGULATIONS

- Table #1 NSPS Source Categories Required to Continuously Monitor III-138
- Table #2 Operational Monitoring Requirements (NSPS) III-140
- Table #3 Emission Limitations (NSPS) III-143
- Table #4 Proposal and Promulgation Dates For NSPS Source Categories III-149
- Table #5 NSPS Continuous Monitoring Requirements III-150
- Table #6 Quarterly Reporting Requirements (NSPS) III-151
- Table #7 Definition of Excess Emissions (NSPS) III-152
- Table #8 Spanning and Zeroing III-154
- Table #9 Span Specifications (NSPS) III-155
- Table #10 Notification Requirements (NSPS) III-156
- Table #11 Specification Requirements (NSPS) III-157
- Table #12 Performance Specifications III-158
- Table #13 When to Run The Monitor Performance Test III-159

Table #14 Requirements for SIP Revisions III-160

Table #15 Existing Sources Required to Continuously Monitor Emissions III-161

Table #16 NESHAP Monitoring Requirements for Vinyl Chloride Sources III-162

CONTINUOUS EMISSION MONITORING REGULATIONS

The Environmental Protection Agency has promulgated revisions to Parts 51, 60, and 61 of Title 40 of the Code of Federal Regulations to require stationary sources of air pollution to install, operate, and maintain continuous emission monitoring systems.

On October 21, 1976, the Environmental Protection Agency added vinyl chloride to the list of hazardous air pollutants that are regulated by National Emission Standards for Hazardous Air Pollutants, 40 CFR Part 61. Section 61.68 requires new and existing stationary sources to continuously monitor emissions of vinyl chloride. Existing sources and new sources with a startup date preceding the effective date of the regulation are to comply with the regulation within 90 days after the effective date. New sources with a startup date after the effective date are to comply with the regulation within 90 days after startup. The owners or operators are required to report excess emissions to EPA semiannually, on March 15 and September 15.

The EPA, on October 6, 1975, promulgated a regulation that required States to revise, by October 6, 1976, their State Implementation Plans to include legally enforceable procedures requiring certain categories of existing stationary sources to continuously monitor emissions. The States, as a minimum, must require existing stationary sources in the following categories to install, operate, and maintain equipment to continuously monitor and record emissions: Fossil Fuel Fired Steam Generators, Nitric Acid Plants, Sulfuric Acid Plants, and Petroleum Refineries. The sources shall be required to install monitoring systems that comply with performance specifications and to submit quarterly reports to the State that include the frequency and magnitude of excess emissions and the inoperativeness, repairs, and adjustments of the continuous monitoring systems. The States must require the sources to begin monitoring within 18 months of the SIP approval or EPA promulgation. If the States does not submit SIP revisions or if submitted revisions are inadequate, EPA will promulgate substitute regulations requiring continuous emission monitoring.

Also, on October 6, 1975, the EPA promulgated revisions to New Source Performance Standards (NSPS), 40 CFR Part 60, to require certain specified categories of new and modified stationary sources to install, operate, and maintain equipment to continuously monitor and record emissions. The NSPS regulations require that affected facilities install monitoring systems prior to conducting performance tests of the affected facility as required by 60.8 (unless continuous monitor installation depends upon results of performance test - i.e. NO_x monitor installation). The source is required to evaluate the performance of each emission monitoring system during the performance test or within 30 days thereafter. The source is required to maintain a file of continuous monitoring measurements and to submit quarterly reports that include frequency and magnitude of excess emissions and inoperativeness, repairs, and adjustments of the continuous monitoring systems. Continuous monitoring information and requirements are found in three places in Part 60: Subpart A, General Provisions; Subparts D-AA, Subparts for specific source categories; and Appendix B, Performance Specifications.

Currently the primary purpose of NSPS continuous monitoring, with the exception of Primary Lead, Zinc, and Copper Smelters, is to insure that emission control systems are properly operated and maintained and to serve as indicators of emissions. Continuous monitors at primary smelters are used to determine compliance with SO_2 standards. States have the option of revising their SIP so that continuous monitoring is used for insuring proper operation and maintenance of the emission control equipment or for determining compliance with emissions standards.

This compilation of regulatory information contains excerpts from the three Parts (51, 60 and 61) of the Code of Federal Regulations that require stationary sources to continuously monitor emissions and/or processes. This information is compiled to produce a concise package of updated monitoring regulations. It is intended that this is concise for ease of use, but sufficiently inclusive to answer questions and to allow for interpretations of the monitoring regulations. Parts of the preambles, which contain explanations, discussion, and background information, have been included.

Section I contains monitoring regulations that have been extracted from Part 60, NSPS and is divided into the following parts: current continuous monitoring regulations; excerpts of preambles; and presently proposed regulations and proposed revisions to existing regulations.

Section II contains the required SIP revision requirements promulgated by EPA.

Section III contains the monitoring requirements that are included in Part 61, NESHAP.

Following Section III, there are several summary tables of regulatory information that have been abstracted from NSPS, SIP, and NESHAP monitoring requirements. The tables contain information in useful, concise formats. Since the tables are summaries, they do not include all the examples, exceptions, and exemptions that are included in the regulations. One should refer to the text of the regulations to answer any legal questions that arise or to make regulatory interpretations.

ENVIRONMENTAL PROTECTION AGENCY

STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

Subpart A—General Provisions

§ 60.1 Applicability.

Except as provided in Subparts B and C, the provisions of this part apply to the owner or operator of any stationary source which contains an affected facility, the construction or modification of which is commenced after the date of publication in this part of any standard (or, if earlier, the date of publication of any proposed standard) applicable to that facility.

§ 60.2 Definitions.

As used in this part, all terms not defined herein shall have the meaning given them in the Act:

(a) "Act" means the Clean Air Act (42 U.S.C. 1857 et seq., as amended by Public Law 91–604, 84 Stat. 1676).

(b) "Administrator" means the Administrator of the Environmental Protection Agency or his authorized representative.

(c) "Standard" means a standard of performance proposed or promulgated under this part.

(d) "Stationary source" means any building, structure, facility, or installation which emits or may emit any air pollutant and which contains any one or combination of the following:

(1) Affected facilities.

(2) Existing facilities.

(3) Facilities of the type for which no standards have been promulgated in this part.

(e) "Affected facility" means, with reference to a stationary source, any apparatus to which a standard is applicable.

(f) "Owner or operator" means any person who owns, leases, operates, controls, or supervises an affected facility or a stationary source of which an affected facility is a part.

(g) "Construction" means fabrication, erection, or installation of an affected facility.

(h) "Modification" means any physical change in, or change in the method of operation of, an existing facility which increases the amount of any air pollutant (to which a standard applies) emitted into the atmosphere by that facility or which results in the emission of any air pollutant (to which a standard applies) into the atmosphere not previously emitted.

(i) "Commenced" means, with respect to the definition of "new source" in section 111(a)(2) of the Act, that an owner or operator has undertaken a continuous program of construction or modification or that an owner or operator has entered into a contractual obligation to undertake and complete, within a reasonable time, a continuous program of construction or modification.

(j) "Opacity" means the degree to which emissions reduce the transmission of light and obscure the view of an object in the background.

(k) "Nitrogen oxides" means all oxides of nitrogen except nitrous oxide, as measured by test methods set forth in this part.

(l) "Standard conditions" means a temperature of 20°C (68°F) and a pressure of 760 mm of Hg (29.92 in. of Hg).

(m) "Proportional sampling" means sampling at a rate that produces a constant ratio of sampling rate to stack gas flow rate.

(n) "Isokinetic sampling" means sampling in which the linear velocity of the gas entering the sampling nozzle is equal to that of the undisturbed gas stream at the sample point.

(o) "Startup" means the setting in operation of an affected facility for any purpose.

(p) "Shutdown" means the cessation of operation of an affected facility for any purpose.

(q) "Malfunction" means any sudden and unavoidable failure of air pollution control equipment or process equipment or of a process to operate in a normal or usual manner. Failures that are caused entirely or in part by poor maintenance, careless operation, or any other preventable upset condition or preventable equipment breakdown shall not be considered malfunctions.

(r) "One-hour period" means any 60 minute period commencing on the hour.

(s) "Reference method" means any method of sampling and analyzing for an air pollutant as described in Appendix A to this part.

(t) "Equivalent method" means any method of sampling and analyzing for an air pollutant which have been demonstrated to the Administartor's satisfaction to have a consistent and quantitatively known relationship to the reference method, under specified conditions.

(u) "Alternative method" means any method of sampling and analyzing for an air pollutant which is not a reference or equivalent method but which has been demonstrated to the Administrator's satisfaction to, in specific cases, produce results adequate for his determination of compliance.

(v) "Particulate matter" means any finely divided solid or liquid material, other than uncombined water, as measured by Method 5 of Appendix A to this part or an equivalent or alternative method.

(w) "Run" means the net period of time during which an emission sample is collected. Unless otherwise specified, a run may be either intermittent or continuous within the limits of good engineering practice.

(x) "Six-minute period" means any one of the 10 equal parts of a one-hour period.

(y) "Continuous monitoring system" means the total equipment, required under the emission monitoring sections in applicable subparts, used to sample and condition (if applicable), to analyze, and to provide a permanent record of emissions or process parameters.

(z) "Monitoring device" means the total equipment, required under the monitoring of operations sections in applicable subparts, used to measure and record (if applicable) process parameters.

(aa) "Existing facility" means, with reference to a stationary source, any apparatus of the type for which a standard is promulgated in this part, and the construction or modification of which was commenced before the date of proposal of that standard; or any apparatus which could be altered in such a way as to be of that type.

(bb) "Capital expenditure" means an expenditure for a physical or operational change to an existing facility which exceeds the product of the applicable "annual asset guideline repair allowance percentage" specified in the latest edition of Internal Revenue Service Publication 534 and the existing facility's basis, as defined by section 1012 of the Internal Revenue Code.

* * * * *

§ 60.7 Notification and record keeping.

(a) Any owner or operator subject to the provisions of this part shall furnish the Administrator written notification as follows:

* * * * *

(5) A notification of the date upon which demonstration of the continuous monitoring system performance commences in accordance with § 60.13(c). Notification shall be postmarked not less than 30 days prior to such date.

(b) Any owner or operator subject to the provisions of this part shall maintain records of the occurrence and duration of any startup, shutdown, or malfunction in the operation of an affected facility; any malfunction of the air pollution control equipment; or any periods during which a continuous monitoring system or monitoring device is inoperative.

(c) Each owner or operator required to install a continuous monitoring system shall submit a written report of excess emissions (as defined in applicable subparts) to the Administrator for every calendar quarter. All quarterly reports shall be postmarked by the 30th day following the end of each calendar quarter and shall include the following information:

(1) The magnitude of excess emissions computed in accordance with § 60.13(h), any conversion factor(s) used, and the date and time of commencement and completion of each time period of excess emissions.

(2) Specific identification of each period of excess emissions that occurs during startups, shutdowns, and malfunctions of the affected facility. The nature and cause of any malfunction (if known), the corrective action taken or preventative measures adopted.

(3) The date and time identifying each period during which the continuous monitoring system was inoperative except for zero and span checks and the

nature of the system repairs or adjustments.

(4) When no excess emissions have occurred or the continuous monitoring system(s) have not been inoperative, repaired, or adjusted, such information shall be stated in the report.

(d) Any owner or operator subject to the provisions of this part shall maintain a file of all measurements, including continuous monitoring system, monitoring device, and performance testing measurements; all continuous monitoring system performance evaluations; all continuous monitoring system or monitoring device calibration checks; adjustments and maintenance performed on these systems or devices; and all other information required by this part recorded in a permanent form suitable for inspection. The file shall be retained for at least two years following the date of such measurements, maintenance, reports, and records.

* * * * *

§ 60.8 Performance tests.

(a) Within 60 days after achieving the maximum production rate at which the affected facility will be operated, but not later than 180 days after initial startup of such facility and at such other times as may be required by the Administrator under section 114 of the Act, the owner or operator of such facility shall conduct performance test(s) and furnish the Administrator a written report of the results of such performance test(s).

* * * * *

§ 60.11 Compliance with standards and maintenance requirements.

(a) Compliance with standards in this part, other than opacity standards, shall be determined only by performance tests established by § 60.8.

(b) Compliance with opacity standards in this part shall be determined by conducting observations in accordance with Reference Method 9 in Appendix A of this part or any alternative method that is approved by the Administrator. Opacity readings of portions of plumes which contain condensed, uncombined water vapor shall not be used for purposes of determining compliance with opacity standards. The results of continuous monitoring by transmissometer which indicate that the opacity at the time visual observations were made was not in excess of the standard are probative but not conclusive evidence of the actual opacity of an emission, provided that the source shall meet the burden of proving that the instrument used meets (at the time of the alleged violation) Performance Specification 1 in Appendix B of this part, has been properly maintained and (at the time of the alleged violation) calibrated, and that the resulting data have not been tampered with in any way.

(c) The opacity standards set forth in this part shall apply at all times except during periods of startup, shutdown, malfunction, and as otherwise provided in the applicable standard.

(d) At all times, including periods of startup, shutdown, and malfunction, owners and operators shall, to the extent practicable, maintain and operate any affected facility including associated air pollution control equipment in a manner consistent with good air pollution control practice for minimizing emissions. Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to the Administrator which may include, but is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures, and inspection of the source.

(e)(1) An owner or operator of an affected facility may request the Administrator to determine opacity of emissions from the affected facility during the initial performance tests required by § 60.8.

(2) Upon receipt from such owner or operator of the written report of the results of the performance tests required by § 60.8, the Administrator will make a finding concerning compliance with opacity and other applicable standards. If the Administrator finds that an affected facility is in compliance with all applicable standards for which performance tests are conducted in accordance with § 60.8 of this part but during the time such performance tests are being conducted fails to meet any applicable opacity standard, he shall notify the owner or operator and advise him that he may petition the Administrator within 10 days of receipt of notification to make appropriate adjustment to the opacity standard for the affected facility.

(3) The Administrator will grant such a petition upon a demonstration by the owner or operator that the affected facility and associated air pollution control equipment was operated and maintained in a manner to minimize the opacity of emissions during the performance tests; that the performance tests were performed under the conditions established by the Administrator; and that the affected facility and associated air pollution control equipment were incapable of being adjusted or operated to meet the applicable opacity standard.

(4) The Administrator will establish an opacity standard for the affected facility meeting the above requirements at a level at which the source will be able, as indicated by the performance and opacity tests, to meet the opacity standard at all times during which the source is meeting the mass or concentration emission standard. The Administrator will promulgate the new opacity standard in the FEDERAL REGISTER.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c-9).)

* * * * *

§ 60.13 Monitoring requirements.

(a) Unless otherwise approved by the Administrator or specified in applicable subparts, the requirements of this section shall apply to all continuous monitoring systems required under applicable subparts.

(b) All continuous monitoring systems and monitoring devices shall be installed and operational prior to conducting performance tests under § 60.8. Verification of operational status shall, as a minimum, consist of the following:

(1) For continuous monitoring systems referenced in paragraph (c)(1) of this section, completion of the conditioning period specified by applicable requirements in Appendix B.

(2) For continuous monitoring systems referenced in paragraph (c)(2) of this section, completion of seven days of operation.

(3) For monitoring devices referenced in applicable subparts, completion of the manufacturer's written requirements or recommendations for checking the operation or calibration of the device.

(c) During any performance tests required under § 60.8 or within 30 days thereafter and at such other times as may be required by the Administrator under section 114 of the Act, the owner or operator of any affected facility shall conduct continuous monitoring system performance evaluations and furnish the Administrator within 60 days thereof two or, upon request, more copies of a written report of the results of such tests. These continuous monitoring system performance evaluations shall be conducted in accordance with the following specifications and procedures:

(1) Continuous monitoring systems listed within this paragraph except as provided in paragraph (c)(2) of this section shall be evaluated in accordance with the requirements and procedures contained in the applicable performance specification of Appendix B as follows:

(i) Continuous monitoring systems for measuring opacity of emissions shall comply with Performance Specification 1.

(ii) Continuous monitoring systems for measuring nitrogen oxides emissions shall comply with Performance Specification 2.

(iii) Continuous monitoring systems for measuring sulfur dioxide emissions shall comply with Performance Specification 2.

(iv) Continuous monitoring systems for measuring the oxygen content or carbon dioxide content of effluent gases shall comply with Performance Specification 3.

(2) An owner or operator who, prior to September 11, 1974, entered into a binding contractual obligation to purchase specific continuous monitoring system components except as referenced by paragraph (c)(2)(iii) of this section shall comply with the following requirements:

(i) Continuous monitoring systems for measuring opacity of emissions shall be capable of measuring emission levels within ±20 percent with a confidence level of 95 percent. The Calibration Error Test and associated calculation procedures set forth in Performance Specification 1 of Appendix B shall be used for demonstrating compliance with this specification.

(ii) Continuous monitoring systems for measurement of nitrogen oxides or sulfur dioxide shall be capable of measuring emission levels within ±20 percent with a confidence level of 95 percent. The Calibration Error Test, the Field Test for Accuracy (Relative), and associated operating and calculation procedures set forth in Performance Specification 2 of Appendix B shall be used for demonstrating compliance with this specification.

(iii) Owners or operators of all continuous monitoring systems installed on an affected facility prior to October 6, 1975 are not required to conduct tests under paragraphs (c) (2) (i) and/or (ii) of this section unless requested by the Administrator.

(3) All continuous monitoring systems referenced by paragraph (c)(2) of this section shall be upgraded or replaced (if necessary) with new continuous monitoring systems, and the new or improved systems shall be demonstrated to comply with applicable performance specifications under paragraph (c)(1) of this section on or before September 11, 1979.

(d) Owners or operators of all continuous monitoring systems installed in accordance with the provisions of this part shall check the zero and span drift at least once daily in accordance with the method prescribed by the manufacturer of such systems unless the manufacturer recommends adjustments at shorter intervals, in which case such recommendations shall be followed. The zero and span shall, as a minimum, be adjusted whenever the 24-hour zero drift or 24-hour calibration drift limits of the applicable performance specifications in Appendix B are exceeded. For continuous monitoring systems measuring opacity of emissions, the optical surfaces exposed to the effluent gases shall be cleaned prior to performing the zero or span drift adjustments except that for systems using automatic zero adjustments, the optical surfaces shall be cleaned when the cumulative automatic zero compensation exceeds four percent opacity. Unless otherwise approved by the Administrator, the following procedures, as applicable, shall be followed:

(1) For extractive continuous monitoring systems measuring gases, minimum procedures shall include introducing applicable zero and span gas mixtures into the measurement system as near the probe as is practical. Span and zero gases certified by their manufacturer to be traceable to National Bureau of Standards reference gases shall be used whenever these reference gases are available. The span and zero gas mixtures shall be the same composition as specified in Appendix B of this part. Every six months from date of manufacture, span and zero gases shall be reanalyzed by conducting triplicate analyses with Reference Methods 6 for SO_2, 7 for NO_x, and 3 for O_2 and CO_2, respectively. The gases may be analyzed at less frequent intervals if longer shelf lives are guaranteed by the manufacturer.

(2) For non-extractive continuous monitoring systems measuring gases, minimum procedures shall include upscale check(s) using a certified calibration gas cell or test cell which is functionally equivalent to a known gas concentration. The zero check may be performed by computing the zero value from upscale measurements or by mechanically producing a zero condition.

(3) For continuous monitoring systems measuring opacity of emissions, minimum procedures shall include a method for producing a simulated zero opacity condition and an upscale (span) opacity condition using a certified neutral density filter or other related technique to produce a known obscuration of the light beam. Such procedures shall provide a system check of the analyzer internal optical surfaces and all electronic circuitry including the lamp and photodetector assembly.

(e) Except for system breakdowns, repairs, calibration checks, and zero and span adjustments required under paragraph (d) of this section, all continuous monitoring systems shall be in continuous operation and shall meet minimum frequency of operation requirements as follows:

(1) All continuous monitoring systems referenced by paragraphs (c)(1) and (c)(2) of this section for measuring opacity of emissions shall complete a minimum of one cycle of sampling and analyzing for each successive ten-second period and one cycle of data recording for each successive six-minute period.

(2) All continuous monitoring systems referenced by paragraph (c)(1) of this section for measuring oxides of nitrogen, sulfur dioxide, carbon dioxide, or oxygen shall complete a minimum of one cycle of operation (sampling, analyzing, and data recording) for each successive 15-minute period.

(3) All continuous monitoring systems referenced by paragraph (c)(2) of this section, except opacity, shall complete a minimum of one cycle of operation (sampling, analyzing, and data recording) for each successive one-hour period.

(f) All continuous monitoring systems or monitoring devices shall be installed such that representative measurements of emissions or process parameters from the affected facility are obtained. Additional procedures for location of continuous monitoring systems contained in the applicable Performance Specifications of Appendix B of this part shall be used.

(g) When the effluents from a single affected facility or two or more affected facilities subject to the same emission standards are combined before being released to the atmosphere, the owner or operator may install applicable continuous monitoring systems on each effluent or on the combined effluent. When the affected facilities are not subject to the same emission standards, separate continuous monitoring systems shall be installed on each effluent. When the effluent from one affected facility is released to the atmosphere through more than one point, the owner or operator shall install applicable continuous monitoring systems on each separate effluent unless the installation of fewer systems is approved by the Administrator.

(h) Owners or operators of all continuous monitoring systems for measurement of opacity shall reduce all data to six-minute averages and for systems other than opacity to one-hour averages for time periods under § 60.2 (x) and (r) respectively. Six-minute opacity averages shall be calculated from 24 or more data points equally spaced over each six-minute period. For systems other than opacity, one-hour averages shall be computed from four or more data points equally spaced over each one-hour period. Data recorded during periods of system breakdowns, repairs, calibration checks, and zero and span adjustments shall not be included in the data averages computed under this paragraph. An arithmetic or integrated average of all data may be used. The data output of all continuous monitoring systems may be recorded in reduced or nonreduced form (e.g. ppm pollutant and percent O_2 or lb/million Btu of pollutant). All excess emissions shall be converted into units of the standard using the applicable conversion procedures specified in subparts. After conversion into units of the standard, the data may be rounded to the same number of significant digits used in subparts to specify the applicable standard (e.g., rounded to the nearest one percent opacity).

(i) After receipt and consideration of written application, the Administrator may approve alternatives to any monitoring procedures or requirements of this part including, but not limited to the following:

(1) Alternative monitoring requirements when installation of a continuous monitoring system or monitoring device specified by this part would not provide accurate measurements due to liquid water or other interferences caused by substances with the effluent gases.

(2) Alternative monitoring requirements when the affected facility is infrequently operated.

(3) Alternative monitoring requirements to accommodate continuous monitoring systems that require additional measurements to correct for stack moisture conditions.

(4) Alternative locations for installing continuous monitoring systems or monitoring devices when the owner or operator can demonstrate that installation at alternate locations will enable accurate and representative measurements.

(5) Alternative methods of converting pollutant concentration measurements to units of the standards.

(6) Alternative procedures for performing daily checks of zero and span drift that do not involve use of span gases or test cells.

(7) Alternatives to the A.S.T.M. test methods or sampling procedures specified by any subpart.

(8) Alternative continuous monitoring systems that do not meet the design or performance requirements in Performance Specification 1, Appendix B, but adequately demonstrate a definite and consistent relationship between its measurements and the measurements of opacity by a system complying with the requirements in Performance Specification 1. The Administrator may require that such demonstration be performed for each affected facility.

(9) Alternative monitoring requirements when the effluent from a single affected facility or the combined effluent from two or more affected facilities are released to the atmosphere through more than one point.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c-9).).

* * * * *

Subpart D—Standards of Performance for Fossil-Fuel Fired Steam Generators

§ 60.40 Applicability and designation of affected facility.

(a) The affected facilities to which the provisions of this subpart apply are:

(1) Each fossil-fuel-fired steam generating unit of more than 73 megawatts heat input rate (250 million Btu per hour).

(2) Each fossil-fuel and wood-residue-fired steam generating unit capable of firing fossil fuel at a heat input rate of more than 73 megawatts (250 million Btu per hour).

(b) Any change to an existing fossil-fuel-fired steam generating unit to accommodate the use of combustible materials, other than fossil fuels as defined in this subpart, shall not bring that unit under the applicability of this subpart.

(c) Any facility under paragraph (a) of this section that commences construction or modification after August 17, 1971, is subject to the requirements of this subpart.

§ 60.41 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act, and in subpart A of this part.

(a) "Fossil fuel-fired steam generating unit" means a furnace or boiler used in the process of burning fossil fuel for the purpose of producing steam by heat transfer.

(b) "Fossil fuel" means natural gas, petroleum, coal, and any form of solid, liquid, or gaseous fuel derived from such materials for the purpose of creating useful heat.

(c) "Coal refuse" means waste-products of coal mining, cleaning, and coal preparation operations (e.g. culm, gob, etc.) containing coal, matrix material, clay, and other organic and inorganic material.

(d) "Fossil fuel and wood residue-fired steam generating unit" means a furnace or boiler used in the process of burning fossil fuel and wood residue for the purpose of producing steam by heat transfer.

(e) "Wood residue" means bark, sawdust, slabs, chips, shavings, mill trim, and other wood products derived from wood processing and forest management operations.

§ 60.42 Standard for particulate matter.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any affected facility any gases which:

* * * * *

(2) Exhibit greater than 20 percent opacity except that a maximum of 40 percent opacity shall be permissible for not more than 2 minutes in any hour.

§ 60.43 Standard for sulfur dioxide.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any affected facility any gases which contain sulfur dioxide in excess of:

(1) 340 nanograms per joule heat input (0.80 lb per million Btu) derived from liquid fossil fuel or liquid fossil fuel and wood residue.

(2) 520 nanograms per joule heat input (1.2 lb per million Btu) derived from solid fossil fuel or solid fossil fuel and wood residue.

(b) When different fossil fuels are burned simultaneously in any combination, the applicable standard (in ng/J) shall be determined by proration using the following formula:

$$PS_{SO_2}=\frac{y(340)+z(520)}{y+z}$$

where:

PS_{SO_2} is the prorated standard for sulfur dioxide when burning different fuels simultaneously, in nanograms per joule heat input derived from all fossil fuels fired or from all fossil fuels and wood residue fired,

y is the percentage of total heat input derived from liquid fossil fuel, and

z is the percentage of total heat input derived from solid fossil fuel.

(c) Compliance shall be based on the total heat input from all fossil fuels burned, including gaseous fuels.

§ 60.44 Standard for nitrogen oxides.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any affected facility any gases which contain nitrogen oxides, expressed as NO_2 in excess of:

(1) 86 nanograms per joule heat input (0.20 lb per million Btu) derived from gaseous fossil fuel or gaseous fossil fuel and wood residue.

(2) 130 nanograms per joule heat input (0.30 lb per million Btu) derived from liquid fossil fuel or liquid fossil fuel and wood residue.

(3) 300 nanograms per joule heat input (0.70 lb per million Btu) derived from solid fossil fuel or solid fossil fuel and wood residue (except lignite or a solid fossil fuel containing 25 percent, by weight, or more of coal refuse).

(b) When different fossil fuels are burned simultaneously in any combination, the applicable standards (in ng/J) shall be determined by proration. Compliance shall be determined by using the following formula:

$$PS_{NO_x}=\frac{x(86)+y(130)+z(300)}{x+y+z}$$

where:

PS_{NO_x} is the prorated standard for nitrogen oxides when burning different fuels simultaneously, in nanograms per joule heat input derived from all fossil fuels fired or from all fossil fuels and wood residue fired,

x is the percentage of total heat input derived from gaseous fossil fuel,

y is the percentage of total heat input derived from liquid fossil fuel, and

z is the percentage of total heat input derived from solid fossil fuel (except lignite or a solid fossil fuel containing 25 percent, by weight, or more of coal refuse).

When lignite or a solid fossil fuel containing 25 percent, by weight, or more of coal refuse is burned in combination with gaseous, liquid, other solid fossil fuel, or wood residue, the standard for nitrogen oxides does not apply.

§ 60.45 Emission and fuel monitoring.

(a) Each owner or operator shall install, calibrate, maintain, and operate continuous monitoring systems for measuring the opacity of emissions, sulfur dioxide emissions, nitrogen oxides emissions, and either oxygen or carbon dioxide except as provided in paragraph (b) of this section.

(b) Certain of the continuous monitoring system requirements under paragraph (a) of this section do not apply to owners or operators under the following conditions:

(1) For a fossil fuel-fired steam generator that burns only gaseous fossil fuel, continuous monitoring systems for measuring the opacity of emissions and sulfur dioxide emissions are not required.

(2) For a fossil fuel-fired steam generator that does not use a flue gas desulfurization device, a continuous monitoring system for measuring sulfur dioxide emissions is not required if the owner or operator monitors sulfur dioxide emissions by fuel sampling and analysis under paragraph (d) of this section.

(3) Notwithstanding § 60.13(b), installation of a continuous monitoring system for nitrogen oxides may be delayed until after the initial performance tests under § 60.8 have been conducted. If the owner or operator demonstrates during the performance test that emissions of nitrogen oxides are less than 70 percent of the applicable standards in § 60.44, a continuous monitoring system for measuring nitrogen oxides emissions is not required. If the initial performance test results show that nitrogen oxide emissions are greater than 70 percent of the applicable standard, the owner or operator shall install a continuous monitoring system for nitrogen oxides within one year after the date of the initial performance tests under § 60.8 and comply

with all other applicable monitoring requirements under this part.

(4) If an owner or operator does not install any continuous monitoring systems for sulfur oxides and nitrogen oxides, as provided under paragraphs (b)(1) and (b)(3) or paragraphs (b)(2) and (b)(3) of this section a continuous monitoring system for measuring either oxygen or carbon dioxide is not required.

(c) For performance evaluations under § 60.13(c) and calibration checks under § 60.13(d), the following procedures shall be used:

(1) Reference Methods 6 or 7, as applicable, shall be used for conducting performance evaluations of sulfur dioxide and nitrogen oxides continuous monitoring systems.

(2) Sulfur dioxide or nitric oxide, as applicable, shall be used for preparing calibration gas mixtures under Performance Specification 2 of Appendix B to this part.

(3) For affected facilities burning fossil fuel(s), the span value for a continuous monitoring system measuring the opacity of emissions shall be 80, 90, or 100 percent and for a continuous monitoring system measuring sulfur oxides or nitrogen oxides the span value shall be determined as follows:

[In parts per million]

Fossil fuel	Span value for sulfur dioxide	Span value for nitrogen oxides
Gas	(1)	500
Liquid	1,000	500
Solid	1,500	500
Combinations	1,000y+1,500z	500(x+y)+1,000z

[1] Not applicable.

where:

x = the fraction of total heat input derived from gaseous fossil fuel, and
y = the fraction of total heat input derived from liquid fossil fuel, and
z = the fraction of total heat input derived from solid fossil fuel.

(4) All span values computed under paragraph (c)(3) of this section for burning combinations of fossil fuels shall be rounded to the nearest 500 ppm.

(5) For a fossil fuel-fired steam generator that simultaneously burns fossil fuel and nonfossil fuel, the span value of all continuous monitoring systems shall be subject to the Administrator's approval.

(d) [Reserved]

(e) For any continuous monitoring system installed under paragraph (a) of this section, the following conversion procedures shall be used to convert the continuous monitoring data into units of the applicable standards (ng/J, lb/million Btu):

(1) When a continuous monitoring system for measuring oxygen is selected, the measurement of the pollutant concentration and oxygen concentration shall each be on a consistent basis (wet or dry). Alternative procedures approved by the Administrator shall be used when measurements are on a wet basis. When measurements are on a dry basis, the following conversion procedure shall be used:

$$E=CF\left[\frac{20.9}{20.9-\text{percent } O_2}\right]$$

where:

E, C, F, and %O_2 are determined under paragraph (f) of this section.

(2) When a continuous monitoring system for measuring carbon dioxide is selected, the measurement of the pollutant concentration and carbon dioxide concentration shall each be on a consistent basis (wet or dry) and the following conversion procedure shall be used:

$$E=CF_c\left[\frac{100}{\text{percent } CO_2}\right]$$

where:

E, C, F_c and %CO_2 are determined under paragraph (f) of this section.

(f) The values used in the equations under paragraphs (e)(1) and (2) of this section are derived as follows:

(1) E = pollutant emissions, ng/J (lb/million Btu).

(2) C = pollutant concentration, ng/dscm (lb/dscf), determined by multiplying the average concentration (ppm) for each one-hour period by 4.15×10^4 M ng/dscm per ppm (2.59×10^{-9} M lb/dscf per ppm) where M = pollutant molecular weight, g/g-mole (lb/lb-mole). M = 64.07 for sulfur dioxide and 46.01 for nitrogen oxides.

(3) %O_2, %CO_2 = oxygen or carbon dioxide volume (expressed as percent), determined with equipment specified under paragraph (d) of this section.

(4) F, F_c = a factor representing a ratio of the volume of dry flue gases generated to the calorific value of the fuel combusted (F), and a factor representing a ratio of the volume of carbon dioxide generated to the calorific value of of the fuel combusted (F_c), respectively. Values of F and F_c are given as follows:

(i) For anthracite coal as classified according to A.S.T.M. D 388-66, $F=2.723\times10^{-7}$ dscm/J (10,140 dscf/million Btu) and $F_c=0.532\times10^{-7}$ scm CO_2/J (1,980 scf CO_2/million Btu).

(ii) For subbituminous and bituminous coal as classified according to A.S.T.M. D 388-66, $F=2.637\times10^{-7}$ dscm/J (9,820 dscf/million Btu) and $F_c=0.486\times10^{-7}$ scm CO_2/J (1,810 scf CO_2/million Btu).

(iii) For liquid fossil fuels including crude, residual, and distillate oils, $F=2.476\times10^{-7}$ dscm/J (9,220 dscf/million Btu) and $F_c=0.384\times10^{-7}$ scm CO_2/J (1,430 scf CO_2/million Btu).

(iv) For gaseous fossil fuels, $F=2.347\times10^{-7}$ dscm/J (8,740 dscf/million Btu). For natural gas, propane, and butane fuels, $F_c=0.279\times10^{-7}$ scm CO_2/J (1,040 scf CO_2/million Btu) for natural gas, 0.322×10^{-7} scm CO_2/J (1,200 scf CO_2/million Btu) for propane, and 0.338×10^{-7} scm CO_2/J (1,260 scf CO_2/million Btu) for butane.

(v) For bark $F=2.589\times10^{-7}$ dscm/J (9,640 dscf/million Btu) and $F_c=0.500\times10^{-7}$ scm CO_2/J (1,860 scf CO_2/million Btu). For wood residue other than bark $F=2.492\times10^{-7}$ dscm/J (9,280 dscf/million Btu) and $F_c=0.494\times10^{-7}$ scm CO_2/J (1,840 scf CO_2/million Btu).

(5) The owner or operator may use the following equation to determine an F factor (dscm/J or dscf/million Btu) on a dry basis (if it is desired to calculate F on a wet basis, consult the Administrator) or F_c factor (scm CO_2/J, or scf CO_2/million Btu) on either basis in lieu of the F or F_c factors specified in paragraph (f)(4) of this section:

$$F=10^{-6}\frac{[227.2\ (\text{pct. H})+95.5\ (\text{pct. C})+35.6\ (\text{pct. S})+8.7\ (\text{pct. N})-28.7\ (\text{pct. O})]}{\text{GCV}}.$$

(SI units)

$$F=\frac{10^6[3.64(\%H)+1.53(\%C)+0.57(\%S)+0.14(\%N)-0.46(\%O)]}{GCV}$$

(English units)

$$F_c=\frac{2.0\times10^{-5}\ (\text{pct. C})}{\text{GCV}}.$$

(SI units)

$$F_c=\frac{321\times10^3(\%C)}{GCV}$$

(English units)

(i) H, C, S, N, and O are content by weight of hydrogen, carbon, sulfur, nitrogen, and oxygen (expressed as percent), respectively, as determined on the same basis as GCV by ultimate analysis of the fuel fired, using A.S.T.M. method D3178-74 or D3176 (solid fuels), or computed from results using A.S.T.M. methods D1137-53(70), D1945-64(73), or D1946-67(72) (gaseous fuels) as applicable.

(ii) GCV is the gross calorific value (kJ/kg, Btu/lb) of the fuel combusted, determined by the A.S.T.M. test methods D 2015–66(72) for solid fuels and D 1826–64(70) for gaseous fuels as applicable.

(iii) For affected facilities which fire both fossil fuels and nonfossil fuels, the F or F_c value shall be subject to the Administrator's approval.

(6) For affected facilities firing combinations of fossil fuels or fossil fuels and wood residue, the F or F_c factors determined by paragraphs (f)(4) or (f)(5) of this section shall be prorated in accordance with the applicable formula as follows:

$$F=\sum_{i=1}^{n} X_i F_i \text{ or } F_c=\sum_{i=1}^{n} X_i (F_c)_i$$

where:

X_i = the fraction of total heat input derived from each type of fuel (e.g. natural gas, bituminous coal, wood residue, etc.)

F_i or $(F_c)_i$ = the applicable F or F_c factor for each fuel type determined in accordance with paragraphs (f)(4) and (f)(5) of this section.

n = the number of fuels being burned in combination.

(g) For the purpose of reports required under § 60.7(c), periods of excess emissions that shall be reported are defined as follows:

(1) [Reserved]

(2) Sulfur dioxide. Excess emissions for affected facilities are defined as:

(i) Any three-hour period during which the average emissions (arithmetic average of three contiguous one-hour periods) of sulfur dioxide as measured by a continuous monitoring system exceed the applicable standard under § 60.43.

(ii) [Reserved]

(3) Nitrogen oxides. Excess emissions for affected facilities using a continuous monitoring system for measuring nitrogen oxides are defined as any three-hour period during which the average emissions (arithmetic average of three contiguous one-hour periods) exceed the applicable standards under § 60.44.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c–9).).

* * * * *

References:

60.2
60.7
60.8
60.11
60.13
Reference Methods 6, 7, 9
Specifications 1, 2, 3

Subpart G—Standards of Performance for Nitric Acid Plants

§ 60.70 Applicability and designation of affected facility.

(a) The provisions of this subpart are applicable to each nitric acid production unit, which is the affected facility.

(b) Any facility under paragraph (a) of this section that commences construction or modification after August 17, 1971, is subject to the requirements of this subpart.

§ 60.71 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Nitric acid production unit" means any facility producing weak nitric acid by either the pressure or atmospheric pressure process.

(b) "Weak nitric acid" means acid which is 30 to 70 percent in strength.

§ 60.72 Standard for nitrogen oxides.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any affected facility any gases which:

(1) Contain nitrogen oxides, expressed as NO_2, in excess of 1.5 kg per metric ton of acid produced (3.0 lb per ton), the production being expressed as 100 percent nitric acid.

(2) Exhibit 10 percent opacity, or greater.

§ 60.73 Emission monitoring.

(a) A continuous monitoring system for the measurement of nitrogen oxides shall be installed, calibrated, maintained, and operated by the owner or operator. The pollutant gas used to prepare calibration gas mixtures under paragraph 2.1, Performance Specification 2 and for calibration checks under § 60.13(d) to this part, shall be nitrogen dioxide (NO_2). The span shall be set at 500 ppm of nitrogen dioxide. Reference Method 7 shall be used for conducting monitoring system performance evaluations under § 60.13(c).

(b) The owner or operator shall establish a conversion factor for the purpose of converting monitoring data into units of the applicable standard (kg/metric ton, lb/short ton). The conversion factor shall be established by measuring emissions with the continuous monitoring system concurrent with measuring emissions with the applicable reference method tests. Using only that portion of the continuous monitoring emission data that represents emission measurements concurrent with the reference method test periods, the conversion factor shall be determined by dividing the reference method test data averages by the monitoring data averages to obtain a ratio expressed in units of the applicable standard to units of the monitoring data, i.e., kg/metric ton per ppm (lb/short ton per ppm). The conversion factor shall be reestablished during any performance test under § 60.8 or any continuous monitoring system performance evaluation under § 60.13(c).

(c) The owner or operator shall record the daily production rate and hours of operation.

(d) [Reserved]

(e) For the purpose of reports required under § 60.7(c), periods of excess emissions that shall be reported are defined as any three-hour period during which the average nitrogen oxides emissions (arithmetic average of three contiguous one-hour periods) as measured by a continuous monitoring system exceed the standard under § 60.72(a).

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c-9).).

* * * * *

References:

60.2
60.7
60.8
60.11
60.13
Reference Method 7
Specification 2

Subpart H—Standards of Performance for Sulfuric Acid Plants

§ 60.80 Applicability and designation of affected facility.

(a) The provisions of this subpart are applicable to each sulfuric acid production unit, which is the affected facility.

(b) Any facility under paragraph (a) of this section that commences construction or modification after August 17, 1971, is subject to the requirements of this subpart.

§ 60.81 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Sulfuric acid production unit" means any facility producing sulfuric acid by the contact process by burning elemental sulfur, alkylation acid, hydrogen sulfide, organic sulfides and mercaptans, or acid sludge, but does not include facilities where conversion to sulfuric acid is utilized primarily as a means of preventing emissions to the atmosphere of sulfur dioxide or other sulfur compounds.

(b) "Acid mist" means sulfuric acid mist, as measured by Method 8 of Appendix A to this part or an equivalent or alternative method.

§ 60.82 Standard for sulfur dioxide.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any affected facility any gases which contain sulfur dioxide in excess of 2 kg per metric ton of acid produced (4 lb per ton), the production being expressed as 100 percent H_2SO_4.

* * * * *

§ 60.84 Emission monitoring.

(a) A continuous monitoring system for the measurement of sulfur dioxide shall be installed, calibrated, maintained, and operated by the owner or operator. The pollutant gas used to prepare calibration gas mixtures under paragraph 2.1, Performance Specification 2 and for calibration checks under § 60.13(d), shall be sulfur dioxide (SO_2). Reference Method 8 shall be used for conducting monitoring system performance evaluations under § 60.13(c) except that only the sulfur dioxide portion of the Method 8 results shall be used. The span shall be set at 1000 ppm of sulfur dioxide.

(b) The owner or operator shall establish a conversion factor for the purpose of converting monitoring data into units of the applicable standard (kg/metric ton, lb/short ton). The conversion factor shall be determined, as a minimum, three times daily by measuring the concentration of sulfur dioxide entering the converter using suitable methods (e.g., the Reich test, National Air Pollution Control Administration Publication No. 999-AP-13) and calculating the appropriate conversion factor for each eight-hour period as follows:

$$CF = k\left[\frac{1.000 - 0.015r}{r - s}\right]$$

where:

CF = conversion factor (kg/metric ton per ppm, lb/short ton per ppm).

k = constant derived from material balance. For determining CF in metric units, $k = 0.0653$. For determining CF in English units, $k = 0.1306$.

r = percentage of sulfur dioxide by volume entering the gas converter. Appropriate corrections must be made for air injection plants subject to the Administrator's approval.

s = percentage of sulfur dioxide by volume in the emissions to the atmosphere determined by the continuous monitoring system required under paragraph (a) of this section.

(c) The owner or operator shall record all conversion factors and values under paragraph (b) of this section from which they were computed (i.e., CF, r, and s).

(d) [Reserved]

(e) For the purpose of reports under § 60.7(c), periods of excess emissions shall be all three-hour periods (or the arithmetic average of three consecutive one-hour periods) during which the integrated average sulfur dioxide emissions exceed the applicable standards under § 60.82.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c-9).).

* * * * *

References:

60.2
60.7
60.8
60.11
60.13
Reference Method 8
Specification 2

Subpart J—Standards of Performance for Petroleum Refineries

§ 60.100 Applicability and designation of affected facility.

(a) The provisions of this subpart are applicable to the following affected facilities in petroleum refineries: fluid catalytic cracking unit catalyst regenerators, fluid catalytic cracking unit incinerator-waste heat boilers, and fuel gas combustion devices.

(b) Any facility under paragraph (a) of this section that commences construction or modification after June 11, 1973, is subject to the requirements of this subpart.

§ 60.101 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A.

(a) "Petroleum refinery" means any facility engaged in producing gasoline, kerosene, distillate fuel oils, residual fuel oils, lubricants, or other products through distillation of petroleum or through redistillation, cracking or reforming of unfinished petroleum derivatives.

(b) "Petroleum" means the crude oil removed from the earth and the oils derived from tar sands, shale, and coal.

(c) "Process gas" means any gas generated by a petroleum refinery process unit, except fuel gas and process upset gas as defined in this section.

(d) "Fuel gas" means any gas which is generated by a petroleum refinery process unit and which is combusted, including any gaseous mixture of natural gas and fuel gas which is combusted.

(e) "Process upset gas" means any gas generated by a petroleum refinery process unit as a result of start-up, shut-down, upset or malfunction.

(f) "Refinery process unit" means any segment of the petroleum refinery in which a specific processing operation is conducted.

(g) "Fuel gas combustion device" means any equipment, such as process heaters, boilers and flares used to combust fuel gas, but does not include fluid coking unit and fluid catalytic cracking unit incinerator-waste heat boilers or facilities in which gases are combusted to produce sulfur or sulfuric acid.

(h) "Coke burn-off" means the coke removed from the surface of the fluid catalytic cracking unit catalyst by combustion in the catalyst regenerator. The rate of coke burn-off is calculated by the formula specified in § 60.106.

§ 60.102 Standard for particulate matter.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall discharge or cause the discharge into the atmosphere from any fluid catalytic cracking unit catalyst regenerator or from any fluid catalytic cracking unit incinerator-waste heat boiler:

* * * * *

(2) Gases exhibiting greater than 30 percent opacity, except for one six-minute average opacity reading in any one hour period.

* * * * *

§ 60.104 Standard for sulfur dioxide.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall burn in any fuel gas combustion device any fuel gas which contains H_2S in excess of 230 mg/dscm (0.10 gr/dscf), except as provided in paragraph (b) of this section. The combustion of process upset gas in a flare, or the combustion in a flare of process gas or fuel gas which is released to the flare as a result of relief valve leakage, is exempt from this paragraph.

(b) The owner or operator may elect to treat the gases resulting from the combustion of fuel gas in a manner which limits the release of SO_2 to the atmosphere if it is shown to the satisfaction of the Administrator that this prevents SO_2 emissions as effectively as compliance with the requirements of paragraph (a) of this section.

§ 60.105 Emission monitoring.

(a) Continuous monitoring systems shall be installed, calibrated, maintained, and operated by the owner or operator as follows:

(1) A continuous monitoring system for the measurement of the opacity of emissions discharged into the atmosphere from the fluid catalytic cracking unit catalyst regenerator. The continuous monitoring system shall be spanned at 60, 70, or 80 percent opacity.

(2) [Reserved]

(3) A continuous monitoring system for the measurement of sulfur dioxide in the gases discharged into the atmosphere from the combustion of fuel gases (except where a continuous monitoring system for the measurement of hydrogen sulfide is installed under paragraph (a)(4) of this section). The pollutant gas used to prepare calibration gas mixtures under paragraph 2.1, Performance Specification 2 and for calibration checks under § 60.13(d), shall be sulfur dioxide (SO_2). The span shall be set at 100 ppm. For conducting monitoring system performance evaluations under § 60.13(c), Reference Method 6 shall be used.

(4) [Reserved]

(b) [Reserved]

(c) The average coke burn-off rate (thousands of kilogram/hr) and hours of operation for any fluid catalytic cracking unit catalyst regenerator subject to § 60.102 or § 60.103 shall be recorded daily.

(d) For any fluid catalytic cracking unit catalyst regenerator which is subject to § 60.102 and which utilizes an incinerator-waste heat boiler to combust the exhaust gases from the catalyst regenerator, the owner or operator shall record daily the rate of combustion of liquid or solid fossil fuels (liters/hr or kilograms/hr) and the hours of operation during which liquid or solid fossil fuels are combusted in the incinerator-waste heat boiler.

(e) For the purpose of reports under § 60.7(c), periods of excess emissions that shall be reported are defined as follows:

(1) Opacity.

All one- hour periods which contain two or more six-minute periods during which the average opacity as measured by the continuous monitoring system exceeds 30 percent.

(2) [Reserved]

(3) [Reserved]

(4) Any six-hour period during which the average emissions (arithmetic average of six contiguous one-hour periods) of sulfur dioxide as measured by a continuous monitoring system exceed the standard under § 60.104.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c-9).).

References:

60.2
60.7
60.8
60.11
60.13
Reference Methods 6, 9
Specifications 1, 2

Subpart P—Standards of Performance for Primary Copper Smelters

§ 60.160 Applicability and designation of affected facility.

(a) The provisions of this subpart are aplicable to the following affected facilities in primary copper smelters: dryer, roaster, smelting furnace, and copper converter.

(b) Any facility under paragraph (a) of this section that commences construction or modification after October 16, 1974, is subject to the requirements of this subpart.

§ 60.161 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Primary copper smelter" means any installation or any intermediate process engaged in the production of copper from copper sulfide ore concentrates through the use of pyrometallurgical techniques.

(b) "Dryer" means any facility in which a copper sulfide ore concentrate charge is heated in the presence of air to eliminate a portion of the moisture from the charge, provided less than 5 percent of the sulfur contained in the charge is eliminated in the facility.

(c) "Roaster" means any facility in which a copper sulfide ore concentrate charge is heated in the presence of air to eliminate a significant portion (5 percent or more) of the sulfur contained in the charge.

(d) "Calcine" means the solid materials produced by a roaster.

(e) "Smelting" means processing techniques for the melting of a copper sulfide ore concentrate or calcine charge leading to the formation of separate layers of molten slag, molten copper, and/or copper matte.

(f) "Smelting furnace" means any vessel in which the smelting of copper sulfide ore concentrates or calcines is performed and in which the heat necessary for smelting is provided by an electric current, rapid oxidation of a portion of the sulfur contained in the concentrate as it passes through an oxidizing atmosphere, or the combustion of a fossil fuel.

(g) "Copper converter" means any vessel to which copper matte is charged and oxidized to copper.

(h) "Sulfuric acid plant" means any facility producing sulfuric acid by the contact process.

(i) "Fossil fuel" means natural gas, petroleum, coal, and any form of solid, liquid, or gaseous fuel derived from such materials for the purpose of creating useful heat.

(j) "Reverberatory smelting furnace" means any vessel in which the smelting of copper sulfide ore concentrates or calcines is performed and in which the heat necessary for smelting is provided primarily by combustion of a fossil fuel

(k) "Total smelter charge" means the weight (dry basis) of all copper sulfide ore concentrates processed at a primary copper smelter, plus the weight of all other solid materials introduced into the roasters and smelting furnaces at a primary copper smelter, except calcine, over a one-month period.

(l) "High level of volatile impurities" means a total smelter charge containing more than 0.2 weight percent arsenic, 0.1 weight percent antimony, 4.5 weight percent lead or 5.5 weight percent zinc, on a dry basis.

* * * * *

§ 60.163 Standard for sulfur dioxide.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any roaster, smelting furnace, or copper converter any gases which contain sulfur dioxide in excess of 0.065 percent by volume, except as provided in paragraphs (b) and (c) of this section.

(b) Reverberatory smelting furnaces shall be exempted from paragraph (a) of this section during periods when the total smelter charge at the primary copper smelter contains a high level of volatile impurities.

(c) A change in the fuel combusted in a reverberatory smelting furnace shall not be considered a modification under this part.

§ 60.164 Standard for visible emissions.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any dryer any visible emissions which exhibit greater than 20 percent opacity.

(b) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any affected facility that uses a sulfuric acid plant to comply with the standard set forth in § 60.163, any visible emissions which exhibit greater than 20 percent opacity.

§ 60.165 Monitoring of operations.

(a) The owner or operator of any primary copper smelter subject to § 60.163 (b) shall keep a monthly record of the total smelter charge and the weight percent (dry basis) of arsenic, antimony, lead and zinc contained in this charge. The analytical methods and procedures employed to determine the weight of the total smelter charge and the weight percent of arsenic, antimony, lead and zinc shall be approved by the Administrator and shall be accurate to within plus or minus ten percent.

(b) The owner or operator of any primary copper smelter subject to the provisions of this subpart shall install and operate:

(1) A continuous monitoring system to monitor and record the opacity of gases discharged into the atmosphere from any dryer. The span of this system shall be set at 80 to 100 percent opacity.

(2) A continuous monitoring system to monitor and record sulfur dioxide emissions discharged into the atmosphere from any roaster, smelting furnace or copper converter subject to § 60.163 (a). The span of this system shall be set at a sulfur dioxide concentration of 0.20 percent by volume.

(i) The continuous monitoring system performance evaluation required under § 60.13(c) shall be completed prior to the initial performance test required under § 60.8. During the performance evaluation, the span of the continuous monitoring system may be set at a sulfur dioxide concentration of 0.15 percent by volume if necessary to maintain the system output between 20 percent and 90 percent of full scale. Upon completion of the continuous monitoring system performance evaluation, the span of the continuous monitoring system shall be set at a sulfur dioxide concentration of 0.20 percent by volume.

(ii) For the purpose of the continuous monitoring system performance evaluation required under § 60.13(c) the reference method referred to under the Field Test for Accuracy (Relative) in Performance Specification 2 of Appendix B to this part shall be Reference Method 6. For the performance evaluation, each concentration measurement shall be of one hour duration. The pollutant gas used to prepare the calibration gas mixtures required under paragraph 2.1, Performance Specification 2 of Appendix B, and for calibration checks under § 60.13 (d), shall be sulfur dioxide.

(c) Six-hour average sulfur dioxide concentrations shall be calculated and recorded daily for the four consecutive 6-hour periods of each operating day. Each six-hour average shall be determined as the arithmetic mean of the appropriate six contiguous one-hour average sulfur dioxide concentrations provided by the continuous monitoring system installed under paragraph (b) of this section.

(d) For the purpose of reports required under § 60.7(c), periods of excess emissions that shall be reported are defined as follows:

(1) Opacity. Any six-minute period during which the average opacity, as measured by the continuous monitoring system installed under paragraph (b) of this section, exceeds the standard under § 60.164(a).

(2) Sulfur dioxide. All six-hour periods during which the average emissions of sulfur dioxide, as measured by the continuous monitoring system installed under § 60.163, exceed the level of the standard. The Administrator will not consider emissions in excess of the level of the standard for less than or equal to 1.5 percent of the six-hour periods during the quarter as indicative of a potential violation of § 60.11(d) provided the affected facility, including air pollution control equipment, is maintained and operated in a manner consistent with

good air pollution control practice for minimizing emissions during these periods. Emissions in excess of the level of the standard during periods of startup, shutdown, and malfunction are not to be included within the 1.5 percent.

(Secs. 111, 114, and 301(a) of the Clean Air Act as amended (42 U.S.C. 1857c-6, 1857c-9, 1857g(a)).)

References:

60.2
60.7
60.8
60.11
60.13
Reference Methods 6, 9
Specifications 1, 2

Subpart Q—Standards of Performance for Primary Zinc Smelters

§ 60.170 Applicability and designation of affected facility.

(a) The provisions of this subpart are applicable to the following affected facilities in primary zinc smelters: roaster and sintering machine.

(b) Any facility under paragraph (a) of this section that commences construction or modification after October 16, 1974, is subject to the requirements of this subpart.

§ 60.171 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Primary zinc smelter" means any installation engaged in the production, or any intermediate process in the production, of zinc or zinc oxide from zinc sulfide ore concentrates through the use of pyrometallurgical techniques.

(b) "Roaster" means any facility in which a zinc sulfide ore concentrate charge is heated in the presence of air to eliminate a significant portion (more than 10 percent) of the sulfur contained in the charge.

(c) "Sintering machine" means any furnace in which calcines are heated in the presence of air to agglomerate the calcines into a hard porous mass called "sinter."

(d) "Sulfuric acid plant" means any facility producing sulfuric acid by the contact process.

* * * * *

§ 60.173 Standard for sulfur dioxide.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any roaster any gases which contain sulfur dioxide in excess of 0.065 percent by volume.

(b) Any sintering machine which eliminates more than 10 percent of the sulfur initially contained in the zinc sulfide ore concentrates will be considered as a roaster under paragraph (a) of this section.

§ 60.174 Standard for visible emissions.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any sintering machine any visible emissions which exhibit greater than 20 percent opacity.

(b) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any affected facility that uses a sulfuric acid plant to comply with the standard set forth in § 60.173, any visible emissions which exhibit greater than 20 percent opacity.

§ 60.175 Monitoring of operations.

(a) The owner or operator of any primary zinc smelter subject to the provisions of this subpart shall install and operate:

(1) A continuous monitoring system to monitor and record the opacity of gases discharged into the atmosphere from any sintering machine. The span of this system shall be set at 80 to 100 percent opacity.

(2) A continuous monitoring system to monitor and record sulfur dioxide emissions discharged into the atmosphere from any roaster subject to § 60.173. The span of this system shall be set at a sulfur dioxide concentration of 0.20 percent by volume.

(i) The continuous monitoring system performance evaluation required under § 60.13(c) shall be completed prior to the initial performance test required under § 60.8. During the performance evaluation, the span of the continuous monitoring system may be set at a sulfur dioxide concentration of 0.15 percent by volume if necessary to maintain the system output between 20 percent and 90 percent of full scale. Upon completion of the continuous monitoring system performance evaluation, the span of the continuous monitoring system shall be set at a sulfur dioxide concentration of 0.20 percent by volume.

(ii) For the purpose of the continuous monitoring system performance evaluation required under § 60.13(c), the reference method referred to under the Field Test for Accuracy (Relative) in Performance Specification 2 of Appendix B to this part shall be Reference Method 6. For the performance evaluation, each concentration measurement shall be of one hour duration. The pollutant gas used to prepare the calibration gas mixtures required under paragraph 2.1, Performance Specification 2 of Appendix B, and for calibration checks under § 60.13 (d), shall be sulfur dioxide.

(b) Two-hour average sulfur dioxide concentrations shall be calculated and recorded daily for the twelve consecutive 2-hour periods of each operating day. Each two-hour average shall be determined as the arithmetic mean of the appropriate two contiguous one-hour average sulfur dioxide concentrations provided by the continuous monitoring system installed under paragraph (a) of this section.

(c) For the purpose of reports required under § 60.7(c), periods of excess emissions that shall be reported are defined as follows:

(1) Opacity. Any six-minute period during which the average opacity, as measured by the continuous monitoring system installed under paragraph (a) of this section, exceeds the standard under § 60.174(a).

(2) Sulfur dioxide. Any two-hour period, as described in paragraph (b) of this section, during which the average emissions of sulfur dioxide, as measured by the continuous monitoring system installed under paragraph (a) of this section, exceeds the standard under § 60.173.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c-9).)

* * * * *

References:

60.2
60.7
60.8
60.11
60.13
Reference Methods 6, 9
Specifications 1, 2

Subpart R—Standards of Performance for Primary Lead Smelters

§ 60.180 Applicability and designation of affected facility.

(a) The provisions of this subpart are applicable to the following affected facilities in primary lead smelters: sintering machine, sintering machine discharge end, blast furnace, dross reverberatory furnace, electric smelting furnace, and converter.

(b) Any facility under paragraph (a) of this section that commences construction or modification after October 16, 1974, is subject to the requirements of this subpart.

§ 60.181 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Primary lead smelter" means any installation or any intermediate process engaged in the production of lead from lead sulfide ore concentrates through the use of pyrometallurgical techniques.

(b) "Sintering machine" means any furnace in which a lead sulfide ore concentrate charge is heated in the presence of air to eliminate sulfur contained in the charge and to agglomerate the charge into a hard porous mass called "sinter."

(c) "Sinter bed" means the lead sulfide ore concentrate charge within a sintering machine.

(d) "Sintering machine discharge end" means any apparatus which receives sinter as it is discharged from the conveying grate of a sintering machine.

(e) "Blast furnace" means any reduction furnace to which sinter is charged and which forms separate layers of molten slag and lead bullion.

(f) "Dross reverberatory furnace" means any furnace used for the removal or refining of impurities from lead bullion.

(g) "Electric smelting furnace" means any furnace in which the heat necessary for smelting of the lead sulfide ore concentrate charge is generated by passing an electric current through a portion of the molten mass in the furnace.

(h) "Converter" means any vessel to which lead concentrate or bullion is charged and refined.

(i) "Sulfuric acid plant" means any facility producing sulfuric acid by the contact process.

* * * * *

§ 60.183 Standard for sulfur dioxide.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any sintering machine, electric smelting furnace, or converter gases which contain sulfur dioxide in excess of 0.065 percent by volume.

§ 60.184 Standard for visible emissions.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any blast furnace, dross reverberatory furnace, or sintering machine discharge end any visible emissions which exhibit greater than 20 percent opacity.

(b) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any affected facility that uses a sulfuric acid plant to comply with the standard set forth in § 60.183, any visible emissions which exhibit greater than 20 percent opacity.

§ 60.185 Monitoring of operations.

(a) The owner or operator of any primary lead smelter subject to the provisions of this subpart shall install and operate:

(1) A continuous monitoring system to monitor and record the opacity of gases discharged into the atmosphere from any blast furnace, dross reverberatory furnace, or sintering machine discharge end. The span of this system shall be set at 80 to 100 percent opacity.

(2) A continuous monitoring system to monitor and record sulfur dioxide emissions discharged into the atmosphere from any sintering machine, electric furnace or converter subject to § 60.183. The span of this system shall be set at a sulfur dioxide concentration of 0.20 percent by volume.

(i) The continuous monitoring system performance evaluation required under § 60.13(c) shall be completed prior to the initial performance test required under § 60.8. During the performance evaluation, the span of the continuous monitoring system may be set at a sulfur dioxide concentration of 0.15 percent by volume if necessary to maintain the system output between 20 percent and 90 percent of full scale. Upon completion of the continuous monitoring system performance evaluation, the span of the continuous monitoring system shall be set at a sulfur dioxide concentration of 0.20 percent by volume.

(ii) For the purpose of the continuous monitoring system performance evaluation required under § 60.13(c), the reference method referred to under the Field Test for Accuracy (Relative) in Performance Specification 2 of Appendix B to this part shall be Reference Method 6. For the performance evaluation, each concentration measurement shall be of one hour duration. The pollutant gases used to prepare the calibration gas mixtures required under paragraph 2.1, Performance Specification 2 of Appendix B, and for calibration checks under § 60.13 (d), shall be sulfur dioxide.

(b) Two-hour average sulfur dioxide concentrations shall be calculated and recorded daily for the twelve consecutive two-hour periods of each operating day. Each two-hour average shall be determined as the arithmetic mean of the appropriate two contiguous one-hour average sulfur dioxide concentrations provided by the continuous monitoring system installed under paragraph (a) of this section.

(c) For the purpose of reports required under § 60.7(c), periods of excess emissions that shall be reported are defined as follows:

(1) Opacity. Any six-minute period during which the average opacity, as measured by the continuous monitoring system installed under paragraph (a) of this section, exceeds the standard under § 60.184(a).

(2) Sulfur dioxide. Any two-hour period, as described in paragraph (b) of this section, during which the average emissions of sulfur dioxide, as measured by the continuous monitoring system installed under paragraph (a) of this section, exceeds the standard under § 60.183.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c-9).).

* * * * *

References:

60.2
60.7
60.8
60.11
60.13
Reference Methods 6, 9
Specifications 1, 2

Subpart T—Standards of Performance for the Phosphate Fertilizer Industry: Wet-Process Phosphoric Acid Plants

§ 60.200 Applicability and designation of affected facility.

(a) The affected facility to which the provisions of this subpart apply is each wet-process phosphoric acid plant. For the purpose of this subpart, the affected facility includes any combination of: reactors, filters, evaporators, and hotwells.

(b) Any facility under paragraph (a) of this section that commences construction or modification after October 22, 1974, is subject to the requirements of this subpart.

§ 60.201 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Wet-process phosphoric acid plant" means any facility manufacturing phosphoric acid by reacting phosphate rock and acid.

(b) "Total fluorides" means elemental fluorine and all fluoride compounds as measured by reference methods specified in § 60.204, or equivalent or alternative methods.

(c) "Equivalent P_2O_5 feed" means the quantity of phosphorus, expressed as phosphorous pentoxide, fed to the process.

* * * * *

§ 60.203 Monitoring of operations.

* * * * *

(c) The owner or operator of any wet-process phosphoric acid subject to the provisions of this part shall install, calibrate, maintain, and operate a monitoring device which continuously measures and permanently records the total pressure drop across the process scrubbing system. The monitoring device shall have an accuracy of ±5 percent over its operating range.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c-9).)

* * * * *

References:

60.2
60.7
60.8
60.11
60.13

Subpart U—Standards of Performance for the Phosphate Fertilizer Industry: Superphosphoric Acid Plants

§ 60.210 Applicability and designation of affected facility.

(a) The affected facility to which the provisions of this subpart apply is each superphosphoric acid plant. For the purpose of this subpart, the affected facility includes any combination of: evaporators, hotwells, acid sumps, and cooling tanks.

(b) Any facility under paragraph (a) of this section that commences construction or modification after October 22, 1974, is subject to the requirements of this subpart.

§ 60.211 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Superphosphoric acid plant" means any facility which concentrates wet-process phosphoric acid to 66 percent or greater P_2O_5 content by weight for eventual consumption as a fertilizer.

(b) "Total fluorides" means elemental fluorine and all fluoride compounds as measured by reference methods specified in § 60.214, or equivalent or alternative methods.

(c) "Equivalent P_2O_5 feed" means the quantity of phosphorus, expressed as phosphorous pentoxide, fed to the process.

* * * * *

§ 60.213 Monitoring of operations.

* * * * *

(c) The owner or operator of any superphosphoric acid plant subject to the provisions of this part shall install, calibrate, maintain, and operate a monitoring device which continuously measures and permanently records the total pressure drop across the process scrubbing system. The monitoring device shall have an accuracy of ± 5 percent over its operating range.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c-9).)

* * * * *

References:

60.2
60.7
60.8
60.11
60.13

Subpart V—Standards of Performance for the Phosphate Fertilizer Industry: Diammonium Phosphate Plants

§ 60.220 Applicability and designation of affected facility.

(a) The affected facility to which the provisions of this subpart apply is each granular diammonium phosphate plant. For the purpose of this subpart, the affected facility includes any combination of: reactors, granulators, dryers, coolers, screens, and mills.

(b) Any facility under paragraph (a) of this section that commences construction or modification after October 22, 1974, is subject to the requirements of this subpart.

§ 60.221 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Granular diammonium phosphate plant" means any plant manufacturing granular diammonium phosphate by reacting phosphoric acid with ammonia.

(b) "Total fluorides" means elemental fluorine and all fluoride compounds as measured by reference methods specified in § 60.224, or equivalent or alternative methods.

(c) "Equivalent P_2O_5 feed" means the quantity of phosphorus, expressed as phosphorous pentoxide, fed to the process.

* * * * *

§ 60.223 Monitoring of operations.

* * * * *

(c) The owner or operator of any granular diammonium phosphate plant subject to the provisions of this part shall install, calibrate, maintain, and operate a monitoring device which continuously measures and permanently records the total pressure drop across the scrubbing system. The monitoring device shall have an accuracy of ±5 percent over its operating range.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c–9).).

* * * * *

References:

60.2
60.7
60.8
60.11
60.13

Subpart W—Standards of Performance for the Phosphate Fertilizer Industry: Triple Superphosphate Plants

§ 60.230 Applicability and designation of affected facility.

(a) The affected facility to which the provisions of this subpart apply is each triple superphosphate plant. For the purpose of this subpart, the affected facility includes any combination of: mixers, curing belts (dens), reactors, granulators, dryers, cookers, screens, mills, and facilities which store run-of-pile triple superphosphate.

(b) Any facility under paragraph (a) of this section that commences construction or modification after October 22, 1974, is subject to the requirements of this subpart.

§ 60.231 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Triple superphosphate plant" means any facility manufacturing triple superphosphate by reacting phosphate rock with phosphoric acid. A run-of-pile triple superphosphate plant includes curing and storing.

(b) "Run-of-pile triple superphosphate" means any triple superphosphate that has not been processed in a granulator and is composed of particles at least 25 percent by weight of which (when not caked) will pass through a 16 mesh screen.

(c) "Total fluorides" means elemental fluorine and all fluoride compounds as measured by reference methods specified in § 60.234, or equivalent or alternative methods.

* * * * *

§ 60.233 Monitoring of operations.

* * * * *

(c) The owner or operator of any triple superphosphate plant subject to the provisions of this part shall install, calibrate, maintain, and operate a monitoring device which continuously measures and permanently records the total pressure drop across the process scrubbing system. The monitoring device shall have an accuracy of ±5 percent over its operating range.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c-9).).

* * * * *

References:

60.2
60.7
60.8
60.11
60.13

Subpart X—Standards of Performance for the Phosphate Fertilizer Industry: Granular Triple Superphosphate Storage Facilities

§ 60.240 Applicability and designation of affected facility.

(a) The affected facility to which the provisions of this subpart apply is each granular triple superphosphate storage facility. For the purpose of this subpart, the affected facility includes any combination of: storage or curing piles, conveyors, elevators, screens, and mills.

(b) Any facility under paragraph (a) of this section that commences construction or modification after October 22, 1974, is subject to the requirements of this subpart.

§ 60.241 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Granular triple superphosphate storage facility" means any facility curing or storing granular triple superphosphate.

(b) "Total fluorides" means elemental fluorine and all fluoride compounds as measured by reference methods specified in § 60.244, or equivalent or alternative methods.

(c) "Equivalent P_2O_5 stored" means the quantity of phosphorus, expressed as phosphorus pentoxide, being cured or stored in the affected facility.

(d) "Fresh granular triple superphosphate" means granular triple superphosphate produced no more than 10 days prior to the date of the performance test.

* * * * *

§ 60.243 Monitoring of operations.

* * * * *

(c) The owner or operator of any granular triple superphosphate storage facility subject to the provisions of this part shall install, calibrate, maintain, and operate a monitoring device which continuously measures and permanently records the total pressure drop across the process scrubbing sytem. The monitoring device shall have an accuracy of ±5 percent over its operating range.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c-9).).

* * * * *

References:

60.2
60.7
60.8
60.11
60.13

Subpart Y—Standards of Performance for Coal Preparation Plants

§ 60.250 Applicability and designation of affected facility.

(a) The provisions of this subpart are applicable to any of the following affected facilities in coal preparation plants which process more than 200 tons per day: thermal dryers, pneumatic coal-cleaning equipment (air tables), coal processing and conveying equipment (including breakers and crushers), coal storage systems, and coal transfer and loading systems.

(b) Any facility under paragraph (a) of this section that commences construction or modification after October 24, 1974, is subject to the requirements of this subpart.

§ 60.251 Definitions.

As used in this subpart, all terms not defined herein have the meaning given them in the Act and in Subpart A of this part.

(a) "Coal preparation plant" means any facility (excluding underground mining operations) which prepares coal by one or more of the following processes: breaking, crushing, screening, wet or dry cleaning, and thermal drying.

(b) "Bituminous coal" means solid fossil fuel classified as bituminous coal by A.S.T.M. Designation D-388-66.

(c) "Coal" means all solid fossil fuels classified as anthracite, bituminous, subbituminous, or lignite by A.S.T.M. Designation D-388-66.

(d) "Cyclonic flow" means a spiraling movement of exhaust gases within a duct or stack.

(e) "Thermal dryer" means any facility in which the moisture content of bituminous coal is reduced by contact with a heated gas stream which is exhausted to the atmosphere.

(f) "Pneumatic coal-cleaning equipment" means any facility which classifies bituminous coal by size or separates bituminous coal from refuse by application of air stream(s).

(g) "Coal processing and conveying equipment" means any machinery used to reduce the size of coal or to separate coal from refuse, and the equipment used to convey coal to or remove coal and refuse from the machinery. This includes, but is not limited to, breakers, crushers, screens, and conveyor belts.

(h) "Coal storage system" means any facility used to store coal except for open storage piles.

(i) "Transfer and loading system" means any facility used to transfer and load coal for shipment.

* * * * *

§ 60.253 Monitoring of operations.

(a) The owner or operator of any thermal dryer shall install, calibrate, maintain, and continuously operate monitoring devices as follows:

(1) A monitoring device for the measurement of the temperature of the gas stream at the exit of the thermal dryer on a continuous basis. The monitoring device is to be certified by the manufacturer to be accurate within ±3° Fahrenheit.

(2) For affected facilities that use venturi scrubber emission control equipment:

(i) A monitoring device for the continuous measurement of the pressure loss through the venturi constriction of the control equipment. The monitoring device is to be certified by the manufacturer to be accurate within ±1 inch water gage.

(ii) A monitoring device for the continuous measurement of the water supply pressure to the control equipment. The monitoring device is to be certified by the manufacturer to be accurate within ±5 percent of design water supply pressure. The pressure sensor or tap must be located close to the water discharge point. The Administrator may be consulted for approval of alternative locations.

(b) All monitoring devices under paragraph (a) of this section are to be recalibrated annually in accordance with procedures under § 60.13(b)(3).

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c-9).).

* * * * *

References:

60.2
60.7
60.8
60.11
60.13

Subpart Z—Standards of Performance for Ferroalloy Production Facilities

§ 60.260 Applicability and designation of affected facility.

(a) The provisions of this subpart are applicable to the following affected facilities: electric submerged arc furnaces which produce silicon metal, ferrosilicon, calcium silicon, silicomanganese zirconium, ferrochrome silicon, silvery iron, high-carbon ferrochrome, charge chrome, standard ferromanganese, silicomanganese, ferromanganese silicon, or calcium carbide; and dust-handling equipment.

(b) Any facility under paragraph (a) of this section that commences construction or modification after October 21, 1974, is subject to the requirements of this subpart.

§ 60.261 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Electric submerged arc furnace" means any furnace wherein electrical energy is converted to heat energy by transmission of current between electrodes partially submerged in the furnace charge.

(b) "Furnace charge" means any material introduced into the electric submerged arc furnace and may consist of, but is not limited to, ores, slag, carbonaceous material, and limestone.

(c) "Product change" means any change in the composition of the furnace charge that would cause the electric submerged arc furnace to become subject to a different mass standard applicable under this subpart.

(d) "Slag" means the more or less completely fused and vitrified matter separated during the reduction of a metal from its ore.

(e) "Tapping" means the removal of slag or product from the electric submerged arc furnace under normal operating conditions such as removal of metal under normal pressure and movement by gravity down the spout into the ladle.

(f) "Tapping period" means the time duration from initiation of the process of opening the tap hole until plugging of the tap hole is complete.

(g) "Furnace cycle" means the time period from completion of a furnace product tap to the completion of the next consecutive product tap.

(h) "Tapping station" means that general area where molten product or slag is removed from the electric submerged arc furnace.

(i) "Blowing tap" means any tap in which an evolution of gas forces or projects jets of flame or metal sparks beyond the ladle, runner, or collection hood.

(j) "Furnace power input" means the resistive electrical power consumption of an electric submerged arc furnace as measured in kilowatts.

(k) "Dust-handling equipment" means any equipment used to handle particulate matter collected by the air pollution control device (and located at or near such device) serving any electric submerged arc furnace subject to this subpart.

(l) "Control device" means the air pollution control equipment used to remove particulate matter generated by an electric submerged arc furnace from an effluent gas stream.

(m) "Capture system" means the equipment (including hoods, ducts, fans, dampers, etc.) used to capture or transport particulate matter generated by an affected electric submerged arc furnace to the control device.

(n) "Standard ferromanganese" means that alloy as defined by A.S.T.M. designation A99–66.

(o) "Silicomanganese" means that alloy as defined by A.S.T.M. designation A483–66.

(p) "Calcium carbide" means material containing 70 to [illegible] percent calcium carbide by weight.

(q) "High-carbon ferrochrome" means that alloy as defined by A.S.T.M. designation A101–66 grades HC1 through HC6.

(r) "Charge chrome" means that alloy containing 52 to 70 percent by weight chromium, 5 to 8 percent by weight carbon, and 3 to 6 percent by weight silicon.

(s) "Silvery iron" means any ferrosilicon, as defined by A.S.T.M. designation 100–69, which contains less than 30 percent silicon.

(t) "Ferrochrome silicon" means that alloy as defined by A.S.T.M. designation A482–66.

(u) "Silicomanganese zirconium" means that alloy containing 60 to 65 percent by weight silicon, 1.5 to 2.5 percent by weight calcium, 5 to 7 percent by weight zirconium, 0.75 to 1.25 percent by weight aluminum, 5 to 7 percent by weight manganese, and 2 to 3 percent by weight barium.

(v) "Calcium silicon" means that alloy as defined by A.S.T.M. designation A495–64.

(w) "Ferrosilicon" means that alloy as defined by A.S.T.M. designation A100–69 grades A, B, C, D, and E which contains 50 or more percent by weight silicon.

(x) "Silicon metal" means any silicon alloy containing more than 96 percent silicon by weight.

(y) "Ferromanganese silicon" means that alloy containing 63 to 66 percent by weight manganese, 28 to 32 percent by weight silicon, and a maximum of 0.08 percent by weight carbon.

§ 60.262 Standard for particulate matter.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any electric submerged arc furnace any gases which:

* * * * *

(3) Exit from a control device and exhibit 15 percent opacity or greater.

* * * * *

(b) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any dust-handling equipment any gases which exhibit 10 percent opacity or greater.

* * * * *

§ 60.264 Emission monitoring.

(a) The owner or operator subject to the provisions of this subpart shall install, calibrate, maintain and operate a continuous monitoring system for measurement of the opacity of emissions discharged into the atmosphere from the control device(s).

(b) For the purpose of reports required under § 60.7(c), the owner or operator shall report as excess emissions all six-minute periods in which the average opacity is 15 percent or greater.

* * * * *

§ 60.265 Monitoring of operations.

* * * * *

(b) The owner or operator subject to the provisions of this subpart shall install, calibrate, maintain, and operate a device to measure and continuously record the furnace power input. The furnace power input may be measured at the output or input side of the transformer. The device must have an accuracy of ±5 percent over its operating range.

(c) The owner or operator subject to the provisions of this subpart shall install, calibrate, and maintain a monitoring device that continuously measures and records the volumetric flow rate through each separately ducted hood of the capture system, except as provided under paragraph (e) of this section. The owner or operator of an electric submerged arc furnace that is equipped with a water cooled cover which is designed to contain and prevent escape of the generated gas and particulate matter shall monitor only the volumetric flow rate through the capture system for control of emissions from the tapping station. The owner or operator may install the monitoring device(s) in any appropriate location in the exhaust duct such that reproducible flow rate monitoring will result. The flow rate monitoring device must have an accuracy of ±10 percent over its normal operating range and must be calibrated according to the manufacturer's instructions. The Administrator may require the owner or operator to demonstrate the accuracy of the monitoring device relative to Methods 1 and 2 of Appendix A to this part.

(d) When performance tests are conducted under the provisions of § 60.8 of this part to demonstrate compliance with the standards under §§ 60.262(a) (4) and (5), the volumetric flow rate through each separately ducted hood of the capture system must be determined using the monitoring device required under paragraph (c) of this section. The volumetric flow rates must be determined for furnace power input levels at 50 and 100 percent of the nominal rated capacity of the electric submerged arc furnace. At all times the electric submerged arc furnace is operated, the owner or operator shall maintain the volumetric flow rate at or above the appropriate levels for that furnace power input level determined during the most recent performance test. If emissions due to tapping are captured and ducted separately from emissions of the electric submerged arc furnace, during each tapping period the owner or operator shall maintain the exhaust flow rates through the capture system over the tapping station at or above the levels established during the most recent performance test. Operation at lower flow rates may be considered by the Administrator to be unacceptable operation and maintenance of the affected facility. The owner or operator may request that these flow rates be reestablished by conducting new performance tests under § 60.8 of this part.

(e) The owner or operator may as an alternative to paragraph (c) of this section determine the volumetric flow rate through each fan of the capture system from the fan power consumption, pressure drop across the fan and the fan performance curve. Only data specific to the operation of the affected electric submerged arc furnace are acceptable for demonstration of compliance with the requirements of this paragraph. The owner or operator shall maintain on file a permanent record of the fan performance curve (prepared for a specific temperature) and shall:

(1) Install, calibrate, maintain, and operate a device to continuously measure and record the power consumption of the fan motor (measured in kilowatts), and

(2) Install, calibrate, maintain, and operate a device to continuously measure and record the pressure drop across the fan. The fan power consumption and pressure drop measurements must be synchronized to allow real time comparisons of the data. The monitoring devices must have an accuracy of ±5 percent over their normal operating ranges.

(f) The volumetric flow rate through each fan of the capture system must be determined from the fan power consumption, fan pressure drop, and fan performance curve specified under paragraph (e) of this section, during any performance test required under § 60.8 to demonstrate compliance with the standards under §§ 60.262(a) (4) and (5). The owner or operator shall determine the volumetric flow rate at a representative temperature for furnace power input levels of 50 and 100 percent of the nominal rated capacity of the electric submerged arc furnace. At all times the electric submerged arc furnace is operated, the owner or operator shall maintain the fan power consumption and fan pressure drop at levels such that the volumetric flow rate is at or above the levels established during the most recent performance test for that furnace power input level. If emissions due to tapping are captured and ducted separately from emissions of the electric submerged arc furnace, during each tapping period the owner or operator shall maintain the fan power consumption and fan pressure drop at levels such that the volumetric flow rate is at or above the levels established during the most recent performance test. Operation at lower flow rates may be considered by the Administrator to be unacceptable operation and maintenance of the affected facility. The owner or operator may request that these flow rates be reestablished by conducting new performance tests under § 60.8. The Administrator may require the owner or operator to verify the fan performance curve by monitoring necessary fan operating parameters and determining the gas volume moved relative to Methods 1 and 2 of Appendix A to this part.

(g) All monitoring devices required under paragraphs (c) and (e) of this section are to be checked for calibration annually in accordance with the procedures under § 60.13(b).

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c-9).)

* * * * *

References:

60.2
60.7
60.8
60.11
60.13

Subpart AA—Standards of Performance for Steel Plants: Electric Arc Furnaces

§ 60.270 Applicability and designation of affected facility.

(a) The provisions of this subpart are applicable to the following affected facilities in steel plants: electric arc furnaces and dust-handling equipment.

(b) Any facility under paragraph (a) of this section that commences construction or modification after October 21, 1974, is subject to the requirements of this subpart.

§ 60.271 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and in Subpart A of this part.

(a) "Electric arc furnace" (EAF) means any furnace that produces molten steel and heats the charge materials with electric arcs from carbon electrodes. Furnaces from which the molten steel is cast into the shape of finished products, such as in a foundry, are not affected facilities included within the scope of this definition. Furnaces which, as the primary source of iron, continuously feed prereduced ore pellets are not affected facilities within the scope of this definition.

(b) "Dust-handling equipment" means any equipment used to handle particulate matter collected by the control device and located at or near the control device for an EAF subject to this subpart.

(c) "Control device" means the air pollution control equipment used to remove particulate matter generated by an EAF(s) from the effluent gas stream.

(d) "Capture system" means the equipment (including ducts, hoods, fans, dampers, etc.) used to capture or transport particulate matter generated by an EAF to the air pollution control device.

(e) "Charge" means the addition of iron and steel scrap or other materials into the top of an electric arc furnace.

(f) "Charging period" means the time period commencing at the moment an EAF starts to open and ending either three minutes after the EAF roof is returned to its closed position or six minutes after commencement of opening of the roof, whichever is longer.

(g) "Tap" means the pouring of molten steel from an EAF.

(h) "Tapping period" means the time period commencing at the moment an EAF begins to tilt to pour and ending either three minutes after an EAF returns to an upright position or six minutes after commencing to tilt, whichever is longer.

* * * * *

§ 60.272 Standard for particulate matter.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from an electric arc furnace any gases which:

* * * * *

(2) Exit from a control device and exhibit three percent opacity or greater.

(3) Exit from a shop and, due solely to operations of any EAF(s), exhibit greater than zero percent shop opacity except:

(i) Shop opacity greater than zero percent, but less than 20 percent, may occur during charging periods.

(ii) Shop opacity greater than zero percent, but less than 40 percent, may occur during tapping periods.

(iii) Opacity standards under paragraph (a)(3) of this section shall apply only during periods when flow rates and pressures are being established under § 60.274 (c) and (f).

(iv) Where the capture system is operated such that the roof of the shop is closed during the charge and the tap, and emissions to the atmosphere are prevented until the roof is opened after completion of the charge or tap, the shop opacity standards under paragraph (a)(3) of this section shall apply when the roof is opened and shall continue to apply for the length of time defined by the charging and/or tapping periods.

(b) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from dust-handling equipment any gases which exhibit 10 percent opacity or greater.

§ 60.273 Emission monitoring.

(a) A continuous monitoring system for the measurement of the opacity of emissions discharged into the atmosphere from the control device(s) shall be installed, calibrated, maintained, and operated by the owner or operator subject to the provisions of this subpart.

(b) For the purpose of reports under § 60.7(c), periods of excess emissions that shall be reported are defined as all six-minute periods during which the average opacity is three percent or greater.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c–9).).

* * * * *

References:

60.2
60.7
60.8
60.11
60.13

Appendix A—Reference Methods

The reference methods in this appendix are referred to in § 60.8 (Performance Tests) and § 60.11 (Compliance With Standards and Maintenance Requirements) of 40 CFR Part 60, Subpart A (General Provisions). Specific uses of these reference methods are described in the standards of performance contained in the subparts, beginning with Subpart D. .

Within each standard of performance, a section titled "Test Methods and Procedures" is provided to (1) identify the test methods applicable to the facility subject to the respective standard and (2) identify any special instructions or conditions to be followed when applying a method to the respective facility. Such instructions (for example, establish sampling rates, volumes, or temperatures) are to be used either in addition to, or as a substitute for procedures in a reference method. Similarly, for sources subject to emission monitoring requirements, specific instructions pertaining to any use of a reference method are provided in the subpart or in Appendix B.

Inclusion of methods in this appendix is not intended as an endorsement or denial of their applicability to sources that are not subject to standards of performance. The methods are potentially applicable to other sources; however, applicability should be confirmed by careful and appropriate evaluation of the conditions prevalent at such sources.

The approach followed in the formulation of the reference methods involves specifications for equipment, procedures, and performance. In concept, a performance specification approach would be preferable in all methods because this allows the greatest flexibility to the user. In practice, however, this approach is impractical in most cases because performance specifications cannot be established. Most of the methods described herein, therefore, involve specific equipment specifications and procedures, and only a few methods in this appendix rely on performance criteria.

Minor changes in the reference methods should not necessarily affect the validity of the results and it is recognized that alternative and equivalent methods exist. Section 60.8 provides authority for the Administrator to specify or approve (1) equivalent methods, (2) alternative methods, and (3) minor changes in the methodology of the reference methods. It should be clearly understood that unless otherwise identified all such methods and changes must have prior approval of the Administrator. An owner employing such methods or deviations from the reference methods without obtaining prior approval does so at the risk of subsequent disapproval and retesting with approved methods.

Within the reference methods, certain specific equipment or procedures are recognized as being acceptable or potentially acceptable and are specifically identified in the methods. The items identified as acceptable options may be used without approval but must be identified in the test report. The potentially approvable options are cited as "subject to the approval of the Administrator" or as "or equivalent." Such potentially approvable techniques or alternatives may be used at the discretion of the owner without prior approval. However, detailed descriptions for applying these potentially approvable techniques or alternatives are not provided in the reference methods. Also, the potentially approvable options are not necessarily acceptable in all applications. Therefore, an owner electing to use such potentially approvable techniques or alternatives is responsible for: (1) assuring that the techniques or alternatives are in fact applicable and are properly executed; (2) including a written description of the alternative method in the test report (the written method must be clear and must be capable of being performed without additional instruction, and the degree of detail should be similar to the detail contained in the reference methods); and (3) providing any rationale or supporting data necessary to show the validity of the alternative in the particular application. Failure to meet these requirements can result in the Administrator's disapproval of the alternative.

Method 1—Sample and Velocity Traverses for Stationary Sources

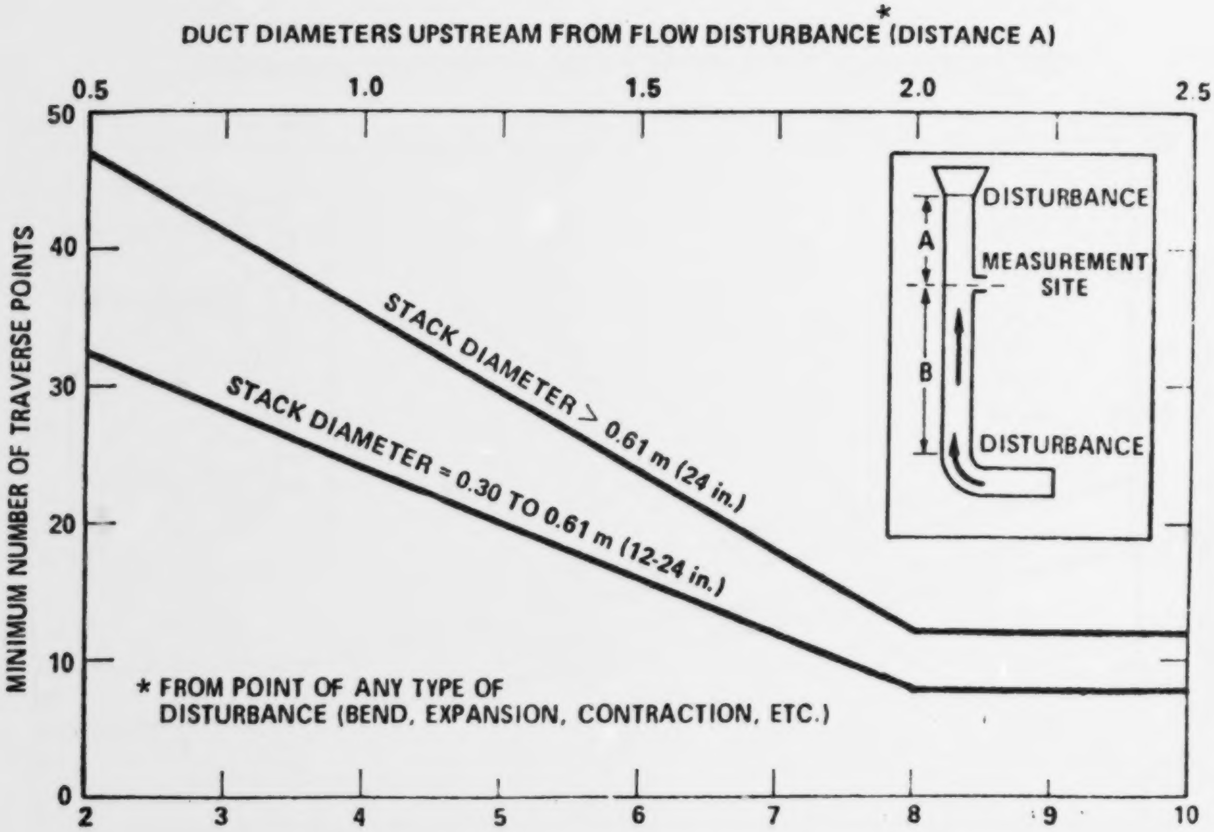


Figure 1-1. Minimum number of traverse points for particulate traverses.

1. *Principle and Applicability*

1.1 Principle. To aid in the representative measurement of pollutant emissions and/or total volumetric flow rate from a stationary source, a measurement site where the effluent stream is flowing in a known direction is selected, and the cross-section of the stack is divided into a number of equal areas. A traverse point is then located within each of these equal areas.

1.2 Applicability. This method is applicable to flowing gas streams in ducts, stacks, and flues. The method cannot be used when: (1) flow is cyclonic or swirling (see Section 2.4), (2) a stack is smaller than about 0.30 meter (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) in cross-sectional area, or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

The requirements of this method must be considered before construction of a new facility from which emissions will be measured; failure to do so may require subsequent alterations to the stack or deviation from the standard procedure. Cases involving variants are subject to approval by the Administrator, U.S. Environmental Protection Agency.

2. *Procedure*

2.1 Selection of Measurement Site. Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream [illegible] a half diameter upstream from any flow disturbance [illegible] a rectangular cross section, an equivalent diameter [illegible] shall be calculated from the following equation, to determine the upstream and downstream distances:

$$D_e = \frac{2LW}{L+W}$$

where L=length and W=width.

2.2 Determining the Number of Traverse Points.

2.2.1 Particulate Traverses. When the eight- and two-diameter criterion can be met, the minimum number of traverse points shall be: (1) twelve, for circular or rectangular stacks with diameters (or equivalent diameters) greater than 0.61 meter (24 in.); (2) eight, for circular stacks with diameters between 0.30 and 0.61 meter (12–24 in.); (3) nine, for rectangular stacks with equivalent diameters between 0.30 and 0.61 meter (12–24 in.).

When the eight- and two-diameter criterion cannot be met, the minimum number of traverse points is determined from Figure 1-1. Before referring to the figure, however, determine the distances from the chosen measurement site to the nearest upstream and downstream disturbances, and divide each distance by the stack diameter or equivalent diameter, to determine the distance in terms of the number of duct diameters. Then, determine from Figure 1-1 the minimum number of traverse points that corresponds: (1) to the number of duct diameters upstream; and (2) to the number of diameters downstream. Select the higher of the two minimum numbers of traverse points, or a greater value, so that for circular stacks the number is a multiple of 4, and for rectangular stacks, the number is one of those shown in Table 1-1.

TABLE 1-1. *Cross-sectional layout for rectangular stacks*

Number of traverse points:	*Matrix layout*
9	3x3
12	4x3
16	4x4
20	5x4
25	5x5
30	6x5
36	6x6
42	7x6
49	7x7

2.2.2 Velocity (Non-Particulate) Traverses. When velocity or volumetric flow rate is to be determined (but not particulate matter), the same procedure as that for particulate traverses (Section 2.2.1) is followed, except that Figure 1-2 may be used instead of Figure 1-1.

2.3 Cross-Sectional Layout and Location of Traverse Points.

2.3.1 Circular Stacks. Locate the traverse points on two perpendicular diameters according to Table 1-2 and the example shown in Figure 1-3. Any equation (for examples, see Citations 2 and 3 in the Bibliography) that gives the same values as those in Table 1-2 may be used in lieu of Table 1-2.

For particulate traverses, one of the diameters must be in a plane containing the greatest expected concentration variation, e.g., after bends, one diameter shall be in the plane of the bend. This requirement becomes less critical as the distance from the disturbance increases; therefore, other diameter locations may be used, subject to approval of the Administrator.

In addition, for stacks having diameters greater than 0.61 m (24 in.) no traverse points shall be located within 2.5 centimeters (1.00 in.) of the stack walls; and for stack diameters equal to or less than 0.61 m (24 in.), no traverse points shall be located within 1.3 cm (0.50 in.) of the stack walls. To meet these criteria, observe the procedures given below.

2.3.1.1 Stacks With Diameters Greater Than 0.61 m (24 in.). When any of the traverse points as located in Section 2.3.1 fall within 2.5 cm (1.00 in.) of the stack walls, relocate them away from the stack walls to: (1) a distance of 2.5 cm (1.00 in.); or (2) a distance equal to the nozzle inside diameter, whichever is larger. These relocated traverse points (on each end of a diameter) shall be the "adjusted" traverse points.

Whenever two successive traverse points are combined to form a single adjusted traverse point, treat the adjusted point as two separate traverse points, both in the sampling (or velocity measurement) procedure, and in recording the data.

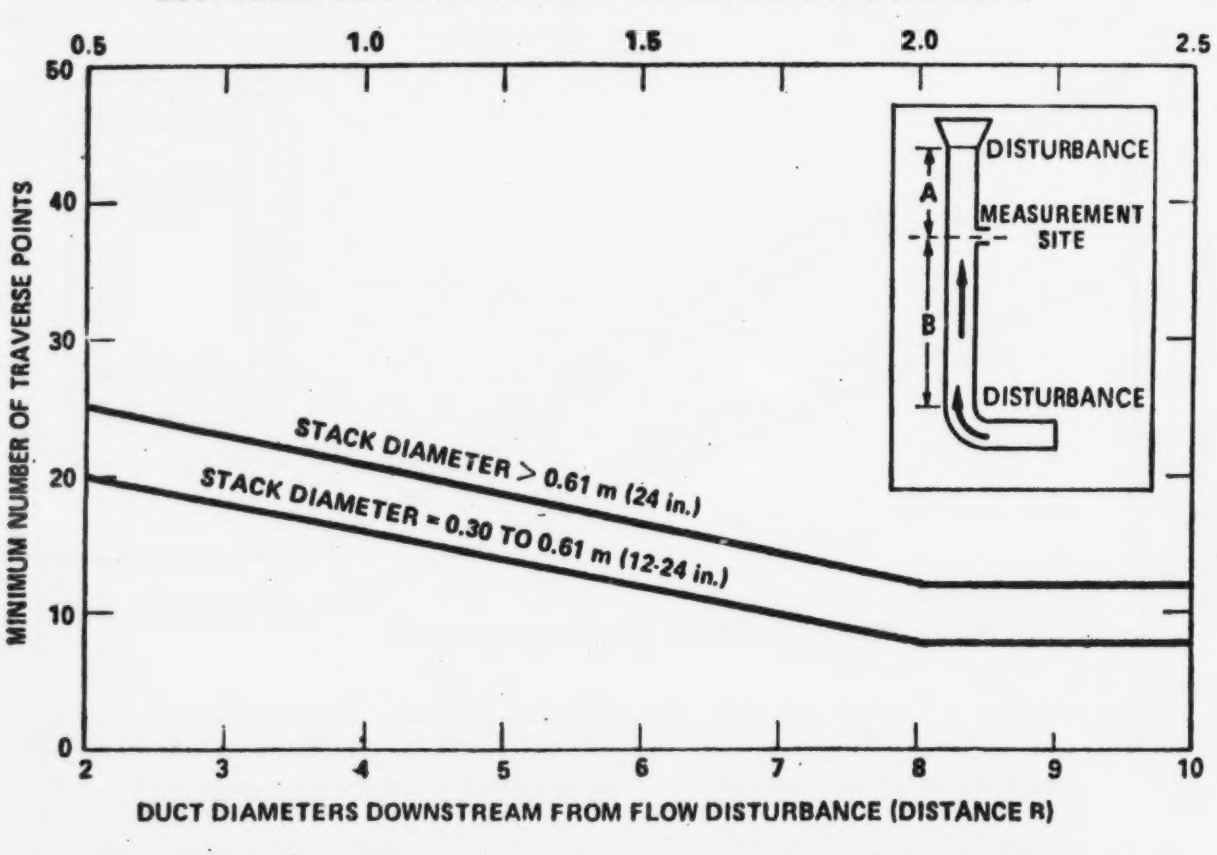


Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

TRAVERSE POINT	DISTANCE, % of diameter
1	4.4
2	14.7
3	29.5
4	70.5
5	85.3
6	95.6

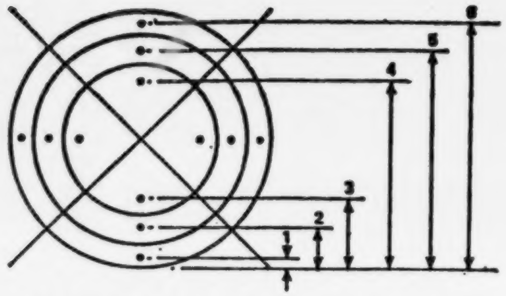


Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

Table 1-2. LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

(Percent of stack diameter from inside wall to traverse point)

Traverse point number on a diameter	Number of traverse points on a diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.8	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

2.3.1.2 Stacks With Diameters Equal to or Less Than 0.61 m (24 in.). Follow the procedure in Section 2.3.1.1, noting only that any "adjusted" points should be relocated away from the stack walls to: (1) a distance of 1.3 cm (0.50 in.); or (2) a distance equal to the nozzle inside diameter, whichever is larger.

2.3.2 Rectangular Stacks. Determine the number of traverse points as explained in Sections 2.1 and 2.2 of this method. From Table 1-1, determine the grid configuration. Divide the stack cross-section into as many equal rectangular elemental areas as traverse points, and then locate a traverse point at the centroid of each equal area according to the example in Figure 1-4.

The situation of traverse points being too close to the stack walls is not expected to arise with rectangular stacks. If this problem should ever arise, the Administrator must be contacted for resolution of the matter.

2.4 Verification of Absence of Cyclonic Flow. In most stationary sources, the direction of stack gas flow is essentially parallel to the stack walls. However, cyclonic flow may exist (1) after such devices as cyclones and inertial demisters following venturi scrubbers, or (2) in stacks having tangential inlets or other duct configurations which tend to induce swirling; in these instances, the presence or absence of cyclonic flow at the sampling location must be determined. The following techniques are acceptable for this determination.

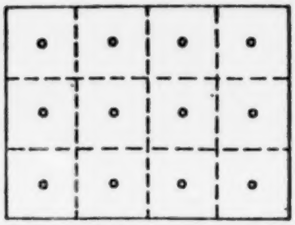


Figure 1-4. Example showing rectangular stack cross section divided into 12 equal areas, with a traverse point at centroid of each area.

Level and zero the manometer. Connect a Type S pitot tube to the manometer. Position the Type S pitot tube at each traverse point, in succession, so that the planes of the face openings of the pitot tube are perpendicular to the stack cross-sectional plane: when the Type S pitot tube is in this position, it is at "0° reference." Note the differential pressure (Δp) reading at each traverse point. If a null (zero) pitot reading is obtained at 0° reference at a given traverse point, an acceptable flow condition exists at that point. If the pitot reading is not zero at 0° reference, rotate the pitot tube (up to ±90° yaw angle), until a null reading is obtained. Carefully determine and record the value of the rotation angle (α) to the nearest degree. After the null technique has been applied at each travrse point, calculate the average of the absolute values of α; assign α values of 0° to those points for which no rotation was required, and include these in the overall average. If the average value of α is greater than 10°, the overall flow condition in the stack is unacceptable and alternative methodology, subject to the approval of the Administrator, must be used to perform accurate sample and velocity traverses.

3. *Bibliography*

1. Determining Dust Concentration in a Gas Stream. ASME. Performance Test Code No. 27. New York. 1957.

2. Devorkin, Howard, et al. Air Pollution Source Testing Manual. Air Pollution Control District. Los Angeles, CA. November 1963

3. Methods for Determination of Velocity, Volume, Dust and Mist Content of Gases. Western Precipitation Division of Joy Manufacturing Co. Los Angeles, CA. Bulletin WP-50. 1968.

4. Standard Method for Sampling Stacks for Particulate Matter. In: 1971 Book of ASTM Standards, Part 23. ASTM Designation D-2928-71. Philadelphia, Pa. 1971.

5. Hanson, H. A., et al. Particulate Sampling Strategies for Large Power Plants Including Nonuniform Flow. USEPA, ORD, ESRL, Research Triangle Park, N.C. EPA-600/2-76-170. June 1976.

6. Entropy Environmentalists, Inc. Determination of the Optimum Number of Sampling Points: An Analysis of Method 1 Criteria. Environmental Protection Agency. Research Triangle Park, N.C. EPA Contract No. 68-01-3172, Task 7.

METHOD 2—DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE (TYPE S PITOT TUBE)

1. *Principle and Applicability*

1.1 Principle. The average gas velocity in a stack is determined from the gas density and from measurement of the average velocity head with a Type S (Stauscheibe or reverse type) pitot tube.

1.2 Applicability. This method is applicable for measurement of the average velocity of a gas stream and for quantifying gas flow.

This procedure is not applicable at measurement sites which fail to meet the criteria of Method 1, Section 2.1. Also, the method cannot be used for direct measurement in cyclonic or swirling gas streams; Section 2.4 of Method 1 shows how to determine cyclonic or swirling flow conditions. When unacceptable conditions exist, alternative procedures, subject to the approval of the Administrator, U.S. Environmental Protection Agency, must be employed to make accurate flow rate determinations; examples of such alternative procedures are: (1) to install straightening vanes; (2) to calculate the total volumetric flow rate stoichiometrically, or (3) to move to another measurement site at which the flow is acceptable.

2. *Apparatus*

Specifications for the apparatus are given below. Any other apparatus that has been demonstrated (subject to approval of the Administrator) to be capable of meeting the specifications will be considered acceptable.

2.1 Type S Pitot Tube. The Type S pitot tube (Figure 2-1) shall be made of metal tubing (e.g., stainless steel). It is recommended that the external tubing diameter (dimension D_t, Figure 2-2b) be between 0.48 and 0.95 centimeters ($\frac{3}{16}$ and $\frac{3}{8}$ inch). There shall be an equal distance from the base of each leg of the pitot tube to its face-opening plane (dimensions P_A and P_B, Figure 2-2b); it is recommended that this distance be between 1.05 and 1.50 times the external tubing diameter. The face openings of the pitot tube shall, preferably, be aligned as shown in Figure 2-2; however, slight misalignments of the openings are permissible (see Figure 2-3).

The Type S pitot tube shall have a known coefficient, determined as outlined in Section 4. An identification number shall be assigned to the pitot tube; this number shall be permanently marked or engraved on the body of the tube.

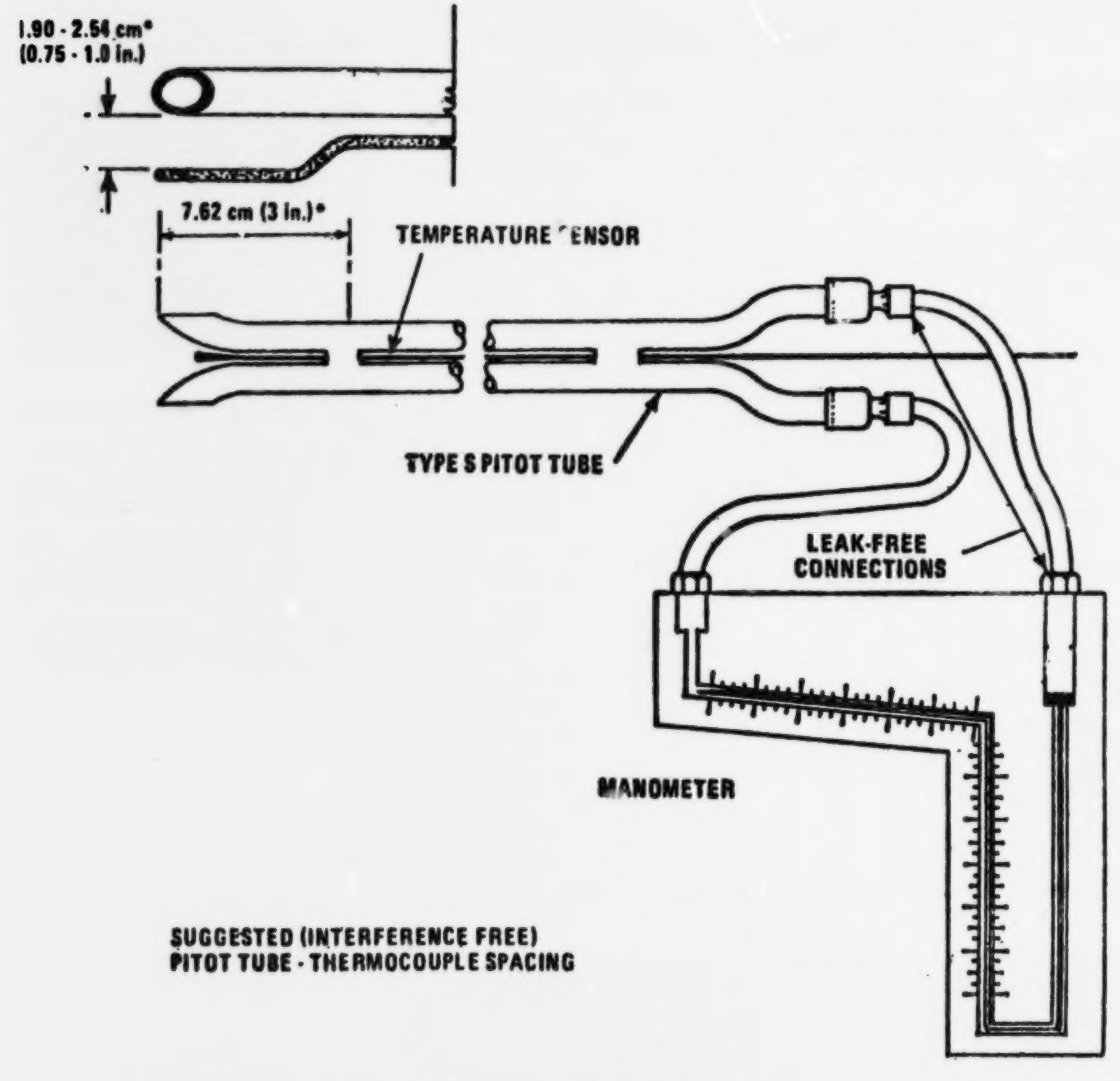


Figure 2-1. Type S pitot tube manometer assembly.

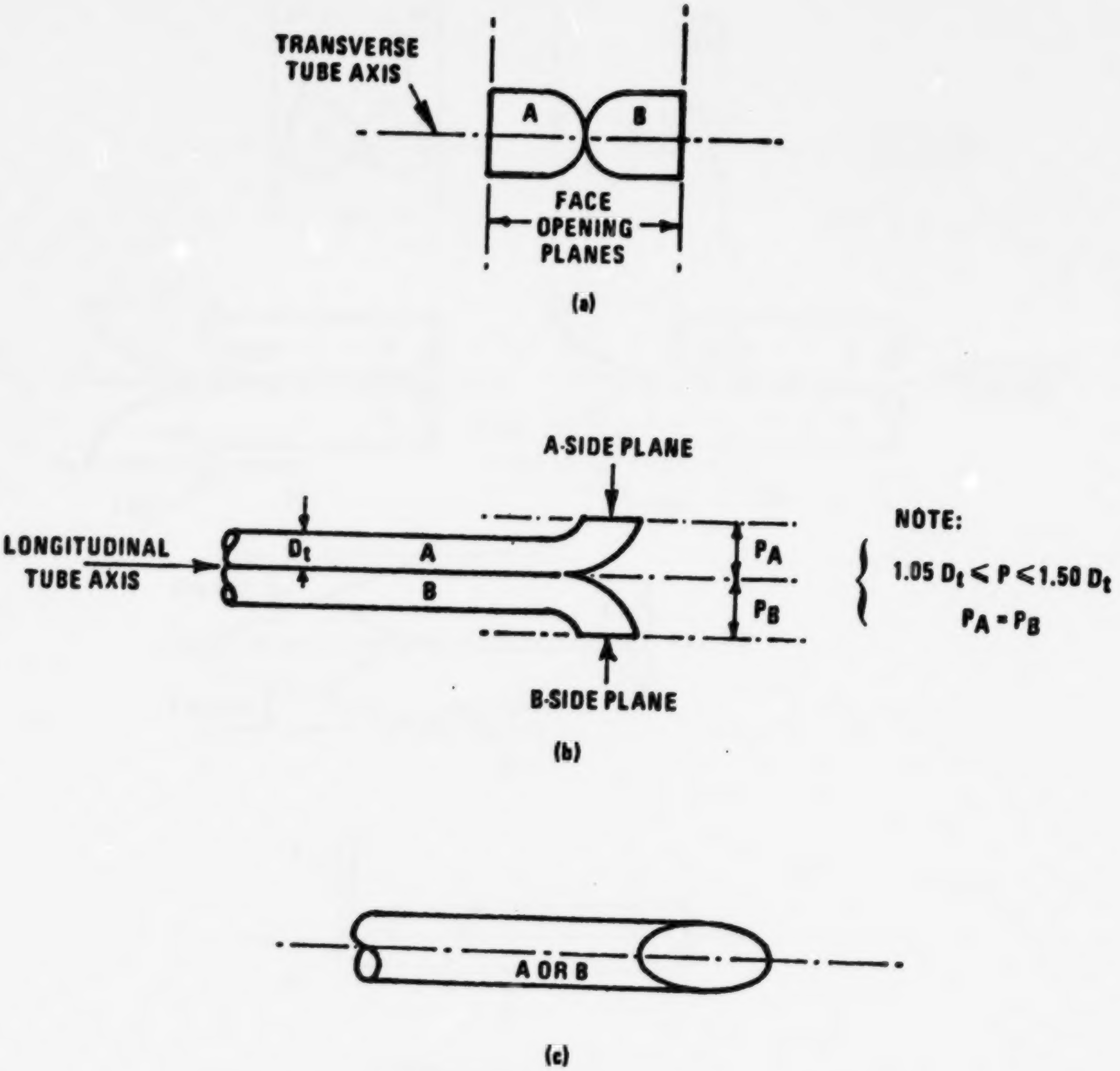

TRANSVERSE TUBE AXIS
A
B
FACE OPENING PLANES
(a)
A-SIDE PLANE
LONGITUDINAL TUBE AXIS
D_t
A
B
P_A
P_B
NOTE:
$1.05\ D_t < P < 1.50\ D_t$
$P_A = P_B$
B-SIDE PLANE
(b)
A OR B
(c)

Figure 2-2. Properly constructed Type S pitot tube, shown in: (a) end view; face opening planes perpendicular to transverse axis; (b) top view; face opening planes parallel to longitudinal axis; (c) side view; both legs of equal length and centerlines coincident, when viewed from both sides. Baseline coefficient values of 0.84 may be assigned to pitot tubes constructed this way.

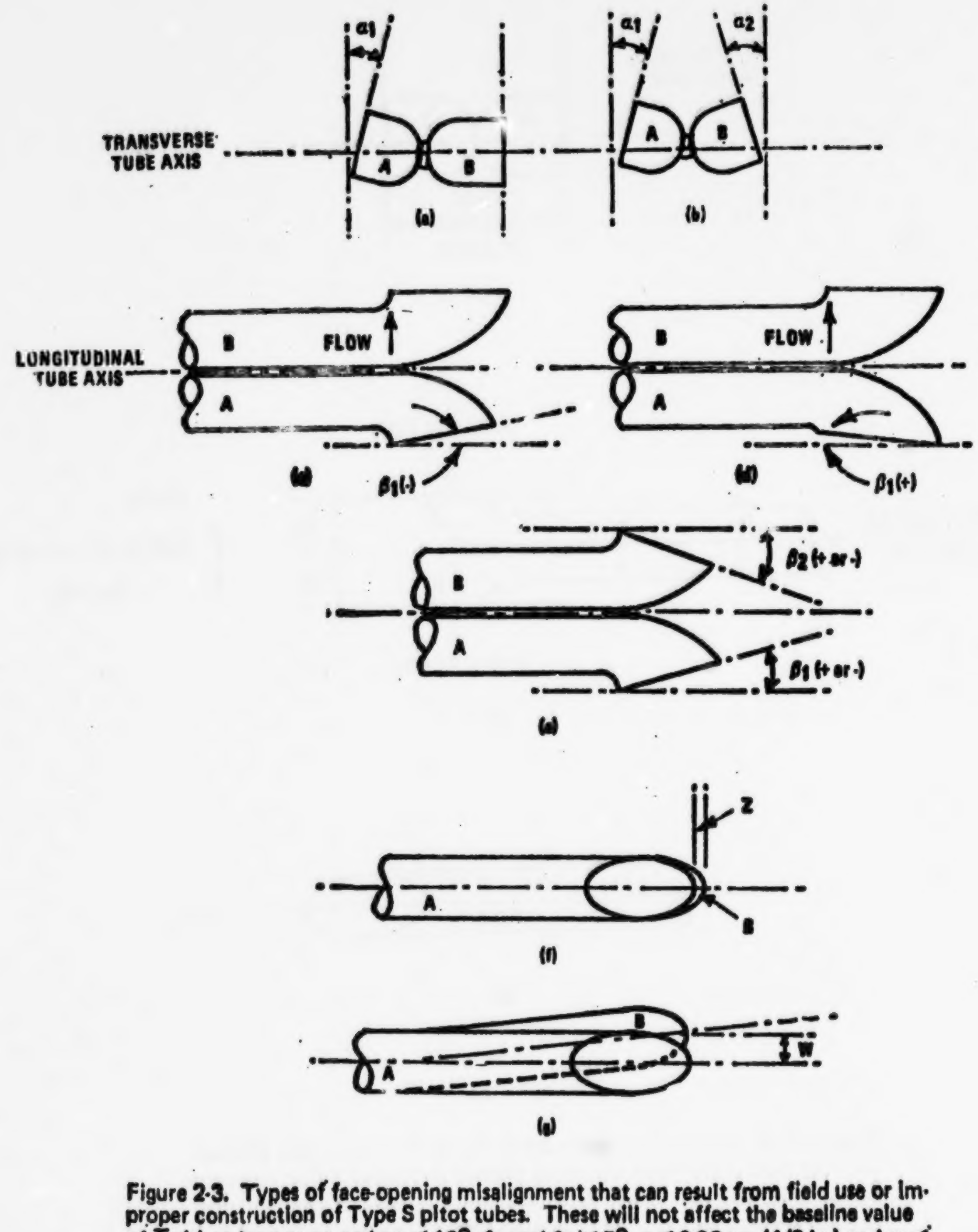

α1
α2
TRANSVERSE TUBE AXIS
A
B
(a)
(b)
LONGITUDINAL TUBE AXIS
FLOW
(c)
β1(-)
(d)
β1(+)
β2 (+ or -)
β1 (+ or -)
(e)
Z
(f)
W
(g)

Figure 2-3. Types of face-opening misalignment that can result from field use or improper construction of Type S pitot tubes. These will not affect the baseline value of $\bar{C}p(s)$ so long as α_1 and $\alpha_2 < 10^\circ$, β_1 and $\beta_2 < 5^\circ$. $z < 0.32$ cm (1/8 in.) and $w < 0.08$ cm (1/32 in.) (citation 11 in Section 6).

A standard pitot tube may be used instead of a Type S, provided that it meets the specifications of Sections 2.7 and 4.2; note, however, that the static and impact pressure holes of standard pitot tubes are susceptible to plugging in particulate-laden gas streams. Therefore, whenever a standard pitot tube is used to perform a traverse, adequate proof must be furnished that the openings of the pitot tube have not plugged up during the traverse period; this can be done by taking a velocity head (Δp) reading at the final traverse point, cleaning out the impact and static holes of the standard pitot tube by "back-purging" with pressurized air, and then taking another Δp reading. If the Δp readings made before and after the air purge are the same (±5 percent), the traverse is acceptable. Otherwise, reject the run. Note that if Δp at the final traverse point is unsuitably low, another point may be selected. If "back-purging" at regular intervals is part of the procedure, then comparative Δp readings shall be taken, as above, for the last two back purges at which suitably high Δp readings are observed.

2.2 Differential Pressure Gauge. An inclined manometer or equivalent device is used. Most sampling trains are equipped with a 10-in. (water column) inclined-vertical manometer, having 0.01-in. H_2O divisions on the 0- to 1-in. inclined scale, and 0.1-in. H_2O divisions on the 1- to 10-in. vertical scale. This type of manometer (or other gauge of equivalent sensitivity) is satisfactory for the measurement of Δp values as low as 1.3 mm (0.05 in.) H_2O. However, a differential pressure gauge of greater sensitivity shall be used (subject to the approval of the Administrator), if any of the following is found to be true: (1) the arithmetic average of all Δp readings at the traverse points in the stack is less than 1.3 mm (0.05 in.) H_2O; (2) for traverses of 12 or more points, more than 10 percent of the individual Δp readings are below 1.3 mm (0.05 in.) H_2O; (3) for traverses of fewer than 12 points, more than one Δp reading is below 1.3 mm (0.05 in.) H_2O. Citation 18 in Section 6 describes commercially available instrumentation for the measurement of low-range gas velocities.

As an alternative to criteria (1) through (3) above, the following calculation may be performed to determine the necessity of using a more sensitive differential pressure gauge:

$$T=\frac{\sum_{i=1}^{n}\sqrt{\Delta p_i+K}}{\sum_{i=1}^{n}\sqrt{\Delta p_i}}$$

where:

Δp_i = Individual velocity head reading at a traverse point, mm H_2O (in. H_2O).

n = Total number of traverse points.

K = 0.13 mm H_2O when metric units are used and 0.005 in H_2O when English units are used.

If T is greater than 1.05, the velocity head data are unacceptable and a more sensitive differential pressure gauge must be used.

NOTE.—If differential pressure gauges other than inclined manometers are used (e.g., magnehelic gauges), their calibration must be checked after each test series. To check the calibration of a differential pressure gauge, compare Δp readings of the gauge with those of a gauge-oil manometer at a minimum of three points, approximately representing the range of Δp values in the stack. If, at each point, the values of Δp as read by the differential pressure gauge and gauge-oil manometer agree to within 5 percent, the differential pressure gauge shall be considered to be in proper calibration. Otherwise, the test series shall either be voided, or procedures to adjust the measured Δp values and final results shall be used, subject to the approval of the Administrator.

2.3 Temperature Gauge. A thermocouple, liquid-filled bulb thermometer, bimetallic thermometer, mercury-in-glass thermometer, or other gauge capable of measuring temperature to within 1.5 percent of the minimum absolute stack temperature shall be used. The temperature gauge shall be attached to the pitot tube such that the sensor tip does not touch any metal; the gauge shall be in an interference-free arrangement with respect to the pitot tube face openings (see Figure 2-1 and also Figure 2-7 in Section 4). Alternate positions may be used if the pitot tube-temperature gauge system is calibrated according to the procedure of Section 4. Provided that a difference of not more than 1 percent in the average velocity measurement is introduced, the temperature gauge need not be attached to the pitot tube; this alternative is subject to the approval of the Administrator.

2.4 Pressure Probe and Gauge. A piezometer tube and mercury- or water-filled U-tube manometer capable of measuring stack pressure to within 2.5 mm (0.1 in.) Hg is used. The static tap of a standard type pitot tube or one leg of a Type S pitot tube with the face opening planes positioned parallel to the gas flow may also be used as the pressure probe.

2.5 Barometer. A mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg) may be used. In many cases, the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and the sampling point shall be applied at a rate of minus 2.5 mm (0.1 in.) Hg per 30-meter (100 foot) elevation increase, or vice-versa for elevation decrease.

2.6 Gas Density Determination Equipment. Method 3 equipment, if needed (see Section 3.6), to determine the stack gas dry molecular weight, and Reference Method 4 or Method 5 equipment for moisture content determination; other methods may be used subject to approval of the Administrator.

2.7 Calibration Pitot Tube. When calibration of the Type S pitot tube is necessary (see Section 4), a standard pitot tube is used as a reference. The standard pitot tube shall, preferably, have a known coefficient, obtained either (1) directly from the National Bureau of Standards, Route 270, Quince Orchard Road, Gaithersburg, Maryland, or (2) by calibration against another standard pitot tube with an NBS-traceable coefficient. Alternatively, a standard pitot tube designed according to the criteria given in 2.7.1 through 2.7.5 below and illustrated in Figure 2-4 (see also Citations 7, 8, and 17 in Section 6) may be used. Pitot tubes designed according to these specifications will have baseline coefficients of about 0.99±0.01.

2.7.1 Hemispherical (shown in Figure 2-4), ellipsoidal, or conical tip.

2.7.2 A minimum of six diameters straight run (based upon D, the external diameter of the tube) between the tip and the static pressure holes.

2.7.3 A minimum of eight diameters straight run between the static pressure holes and the centerline of the external tube, following the 90 degree bend.

2.7.4 Static pressure holes of equal size (approximately 0.1 D), equally spaced in a piezometer ring configuration.

2.7.5 Ninety degree bend, with curved or mitered junction.

2.8 Differential Pressure Gauge for Type S Pitot Tube Calibration. An inclined manometer or equivalent is used. If the single-velocity calibration technique is employed (see Section 4.1.2.3), the calibration differential pressure gauge shall be readable to the nearest 0.13 mm H_2O (0.005 in. H_2O). For multivelocity calibrations, the gauge shall be readable to the nearest 0.13 mm H_2O (0.005 in H_2O) for Δp values between 1.3 and 25 mm H_2O (0.05 and 1.0 in. H_2O), and to the nearest 1.3 mm H_2O (0.05 in. H_2O) for Δp values above 25 mm H_2O (1.0 in. H_2O). A special, more sensitive gauge will be required to read Δp values below 1.3 mm H_2O [0.05 in. H_2O] (see Citation 18 in Section 6).

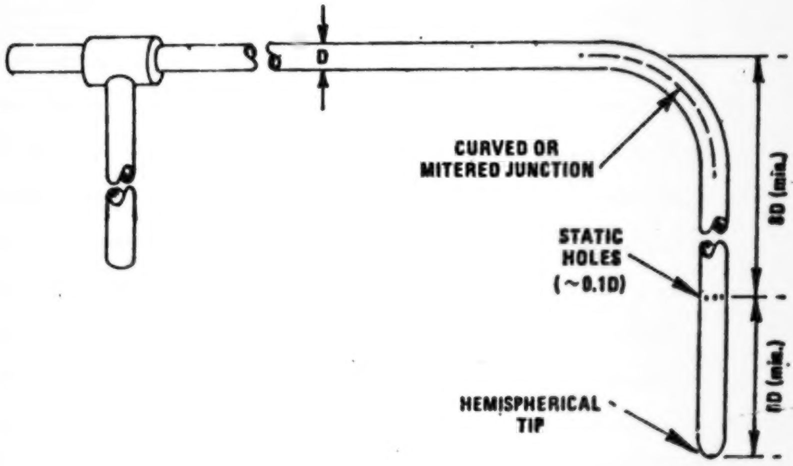


Figure 2-4. Standard pitot tube design specifications.

3. *Procedure*

3.1 Set up the apparatus as shown in Figure 2-1. Capillary tubing or surge tanks installed between the manometer and pitot tube may be used to dampen Δp fluctuations. It is recommended, but not required, that a pretest leak-check be conducted, as follows: (1) blow through the pitot impact opening until at least 7.6 cm (3 in.) H_2O velocity pressure registers on the manometer; then, close off the impact opening. The pressure shall remain stable for at least 15 seconds; (2) do the same for the static pressure side, except using suction to obtain the minimum of 7.6 cm (3 in.) H_2O. Other leak-check procedures, subject to the approval of the Administrator, may be used.

3.2 Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse. Record all necessary data as shown in the example data sheet (Figure 2-5).

3.3 Measure the velocity head and temperature at the traverse points specified by Method 1. Ensure that the proper differential pressure gauge is being used for the range of Δp values encountered (see Section 2.2). If it is necessary to change to a more sensitive gauge, do so, and remeasure the Δp and temperature readings at each traverse point. Conduct a post-test leak-check (mandatory), as described in Section 3.1 above, to validate the traverse run.

3.4 Measure the static pressure in the stack. One reading is usually adequate.

3.5 Determine the atmospheric pressure.

PLANT
DATE RUN NO.
STACK DIAMETER OR DIMENSIONS, m(in.)
BAROMETRIC PRESSURE, mm Hg (in. Hg)
CROSS SECTIONAL AREA, m^2(ft^2)
OPERATORS
PITOT TUBE I.D. NO.
AVG. COEFFICIENT, C_p =
LAST DATE CALIBRATED

SCHEMATIC OF STACK CROSS SECTION

Traverse Pt. No.	Vel. Hd., Δp mm (in.) H_2O	Stack Temperature		P_g mm Hg (in.Hg)	$\sqrt{\Delta p}$
		t_s, °C (°F)	T_s, °K (°R)		
		Average			

Figure 2-5. Velocity traverse data.

3.6 Determine the stack gas dry molecular weight. For combustion processes or processes that emit essentially CO_2, O_2, CO, and N_2, use Method 3. For processes emitting essentially air, an analysis need not be conducted; use a dry molecular weight of 29.0. For other processes, other methods, subject to the approval of the Administrator, must be used.

3.7 Obtain the moisture content from Reference Method 4 (or equivalent) or from Method 5.

3.8 Determine the cross-sectional area of the stack or duct at the sampling location. Whenever possible, physically measure the stack dimensions rather than using blueprints.

4. *Calibration*

4.1 Type S Pitot Tube. Before its initial use, carefully examine the Type S pitot tube in top, side, and end views to verify that the face openings of the tube are aligned within the specifications illustrated in Figure 2-2 or 2-3. The pitot tube shall not be used if it fails to meet these alignment specifications.

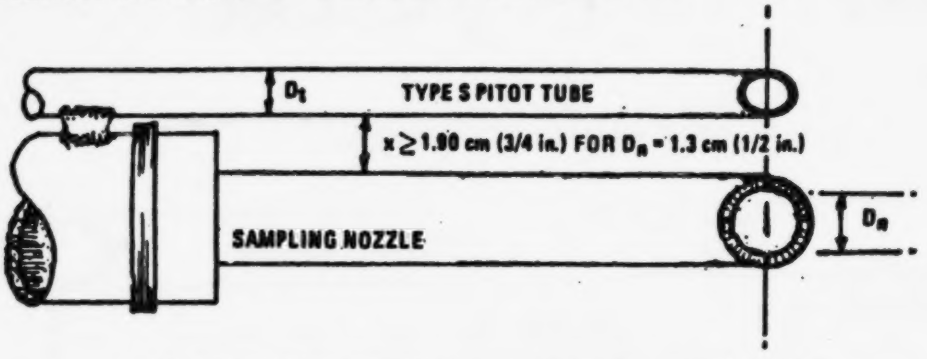
After verifying the face opening alignment, measure and record the following dimensions of the pitot tube: (a) the external tubing diameter (dimension D_t, Figure 2-2b); and (b) the base-to-opening plane distances (dimensions P_A and P_B, Figure 2-2b). If D_t is between 0.48 and 0.95 cm ($\frac{3}{16}$ and $\frac{3}{8}$ in.) and if P_A and P_B are equal and between 1.05 and 1.50 D_t, there are two possible options: (1) the pitot tube may be calibrated according to the procedure outlined in Sections 4.1.2 through 4.1.5 below, or (2) a baseline (isolated tube) coefficient value of 0.84 may be assigned to the pitot tube. Note, however, that if the pitot tube is part of an assembly, calibration may still be required, despite knowledge of the baseline coefficient value (see Section 4.1.1).

If D_t, P_A, and P_B are outside the specified limits, the pitot tube must be calibrated as outlined in 4.1.2 through 4.1.5 below.

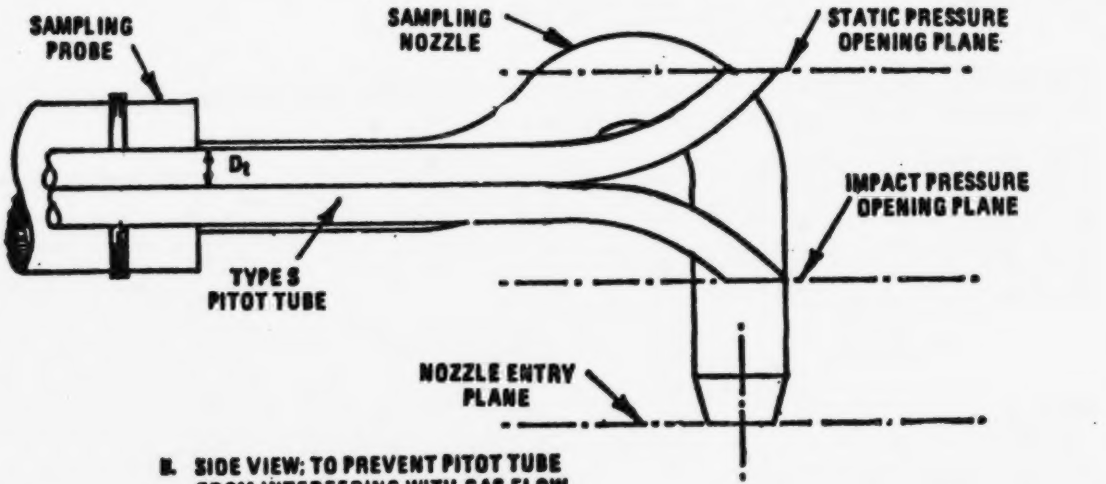
4.1.1 Type S Pitot Tube Assemblies. During sample and velocity traverses, the isolated Type S pitot tube is not always used; in many instances, the pitot tube is used in combination with other source-sampling components (thermocouple, sampling probe, nozzle) as part of an "assembly." The presence of other sampling components can sometimes affect the baseline value of the Type S pitot tube coefficient (Citation 9 in Section 6); therefore an assigned (or otherwise known) baseline coefficient value may or may not be valid for a given assembly. The baseline and assembly coefficient values will be identical only when the relative placement of the components in the assembly is such that aerodynamic interference effects are eliminated. Figures 2-6 through 2-8 illustrate interference-free component arrangements for Type S pitot tubes having external tubing diameters between 0.48 and 0.95 cm ($\frac{3}{16}$ and $\frac{3}{8}$ in.). Type S pitot tube assemblies that fail to meet any or all of the specifications of Figures 2-6 through 2-8 shall be calibrated according to the procedure outlined in Sections 4.1.2 through 4.1.5 below, and prior to calibration, the values of the intercomponent spacings (pitot-nozzle, pitot-thermocouple, pitot-probe sheath) shall be measured and recorded.

NOTE.—Do not use any Type S pitot tube assembly which is constructed such that the impact pressure opening plane of the pitot tube is below the entry plane of the nozzle (see Figure 2-6b).

4.1.2 Calibration Setup. If the Type S pitot tube is to be calibrated, one leg of the tube shall be permanently marked A, and the other, B. Calibration shall be done in a flow system having the following essential design features:



A. BOTTOM VIEW; SHOWING MINIMUM PITOT-NOZZLE SEPARATION.



B. SIDE VIEW; TO PREVENT PITOT TUBE FROM INTERFERING WITH GAS FLOW STREAMLINES APPROACHING THE NOZZLE, THE IMPACT PRESSURE OPENING PLANE OF THE PITOT TUBE SHALL BE EVEN WITH OR ABOVE THE NOZZLE ENTRY PLANE.

Figure 2-6. Proper pitot tube - sampling nozzle configuration to prevent aerodynamic interference; buttonhook - type nozzle; centers of nozzle and pitot opening aligned; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

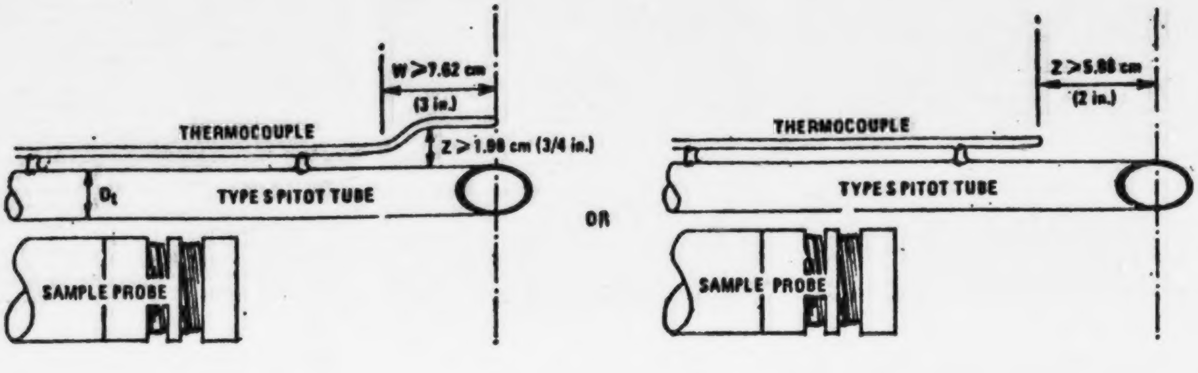


Figure 2-7. Proper thermocouple placement to prevent interference; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

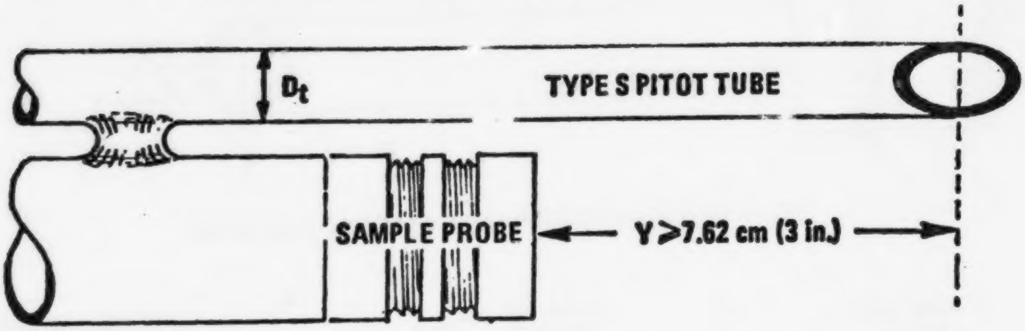


Figure 2-8. Minimum pitot-sample probe separation needed to prevent interference; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

4.1.2.1 The flowing gas stream must be confined to a duct of definite cross-sectional area, either circular or rectangular. For circular cross-sections, the minimum duct diameter shall be 30.5 cm (12 in.); for rectangular cross-sections, the width (shorter side) shall be at least 25.4 cm (10 in.).

4.1.2.2 The cross-sectional area of the calibration duct must be constant over a distance of 10 or more duct diameters. For a rectangular cross-section, use an equivalent diameter, calculated from the following equation, to determine the number of duct diameters:

$$D_e=\frac{2LW}{(L+W)}$$

Equation 2-1

where:
D_e=Equivalent diameter
L=Length
W=Width

To ensure the presence of stable, fully developed flow patterns at the calibration site, or "test section," the site must be located at least eight diameters downstream and two diameters upstream from the nearest disturbances.

NOTE.—The eight- and two-diameter criteria are not absolute; other test section locations may be used (subject to approval of the Administrator), provided that the flow at the test site is stable and demonstrably parallel to the duct axis.

4.1.2.3 The flow system shall have the capacity to generate a test-section velocity around 915 m/min (3,000 ft/min). This velocity must be constant with time to guarantee steady flow during calibration. Note that Type S pitot tube coefficients obtained by single-velocity calibration at 915 m/min (3,000 ft/min) will generally be valid to within ±3 percent for the measurement of velocities above 305 m/min (1,000 ft/min) and to within ±5 to 6 percent for the measurement of velocities between 180 and 305 m/min (600 and 1,000 ft/min). If a more precise correlation between C_p and velocity is desired, the flow system shall have the capacity to generate at least four distinct, time-invariant test-section velocities covering the velocity range from 180 to 1,525 m/min (600 to 5,000 ft/min), and calibration data shall be taken at regular velocity intervals over this range (see Citations 9 and 14 in Section 6 for details).

4.1.2.4 Two entry ports, one each for the standard and Type S pitot tubes, shall be cut in the test section; the standard pitot entry port shall be located slightly downstream of the Type S port, so that the standard and Type S impact openings will lie in the same cross-sectional plane during calibration. To facilitate alignment of the pitot tubes during calibration, it is advisable that the test section be constructed of plexiglas or some other transparent material.

4.1.3 Calibration Procedure. Note that this procedure is a general one and must not be used without first referring to the special considerations presented in Section 4.1.5. Note also that this procedure applies only to single-velocity calibration. To obtain calibration data for the A and B sides of the Type S pitot tube, proceed as follows:

4.1.3.1 Make sure that the manometer is properly filled and that the oil is free from contamination and is of the proper density. Inspect and leak-check all pitot lines; repair or replace if necessary.

4.1.3.2 Level and zero the manometer. Turn on the fan and allow the flow to stabilize. Seal the Type S entry port.

4.1.3.3 Ensure that the manometer is level and zeroed. Position the standard pitot tube at the calibration point (determined as outlined in Section 4.1.5.1), and align the tube so that its tip is pointed directly into the flow. Particular care should be taken in aligning the tube to avoid yaw and pitch angles. Make sure that the entry port surrounding the tube is properly sealed.

4.1.3.4 Read Δp_{std} and record its value in a data table similar to the one shown in Figure 2-9. Remove the standard pitot tube from the duct and disconnect it from the manometer. Seal the standard entry port.

4.1.3.5 Connect the Type S pitot tube to the manometer. Open the Type S entry port. Check the manometer level and zero. Insert and align the Type S pitot tube so that its A side impact opening is at the same point as was the standard pitot tube and is pointed directly into the flow. Make sure that the entry port surrounding the tube is properly sealed.

4.1.3.6 Read Δp_s and enter its value in the data table. Remove the Type S pitot tube from the duct and disconnect it from the manometer.

4.1.3.7 Repeat steps 4.1.3.3 through 4.1.3.6 above until three pairs of Δp readings have been obtained.

4.1.3.8 Repeat steps 4.1.3.3 through 4.1.3.7 above for the B side of the Type S pitot tube.

4.1.3.9 Perform calculations, as described in Section 4.1.4 below.

4.1.4 Calculations.

4.1.4.1 For each of the six pairs of Δp readings (i.e., three from side A and three from side B) obtained in Section 4.1.3 above, calculate the value of the Type S pitot tube coefficient as follows:

PITOT TUBE IDENTIFICATION NUMBER: __________________ **DATE:** ____________

CALIBRATED BY: ______________________________________

	"A" SIDE CALIBRATION			
RUN NO.	Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(s)}$	DEVIATION $C_{p(s)} - \bar{C}_p(A)$
1				
2				
3				
		$\bar{C}_p$ (SIDE A)		

	"B" SIDE CALIBRATION			
RUN NO.	Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(s)}$	DEVIATION $C_{p(s)} - \bar{C}_p(B)$
1				
2				
3				
		$\bar{C}_p$ (SIDE B)		

$$\text{AVERAGE DEVIATION} = \sigma\,(\text{A OR B}) = \frac{\sum_{1}^{3} \left| C_p(s) - \bar{C}_p(\text{A OR B}) \right|}{3} \longleftarrow \text{MUST BE} \le 0.01$$

$$\left| \bar{C}_p\,(\text{SIDE A}) - \bar{C}_p\,(\text{SIDE B}) \right| \longleftarrow \text{MUST BE} < 0.01$$

Figure 2-9. Pitot tube calibration data.

$$C_{p(s)} = C_{p(std)} \sqrt{\frac{\Delta p_{std}}{\Delta p_s}}$$

Equation 2-2

where:

$C_{p(s)}$ = Type S pitot tube coefficient

$C_{p(std)}$ = Standard pitot tube coefficient; use 0.99 if the coefficient is unknown and the tube is designed according to the criteria of Sections 2.7.1 to 2.7.5 of this method.

Δp_{std} = Velocity head measured by the standard pitot tube, cm H_2O (in. H_2O)

Δp_s = Velocity head measured by the Type S pitot tube, cm H_2O (in. H_2O)

4.1.4.2 Calculate $\bar{C}_p$ (side A), the mean A-side coefficient, and $\bar{C}_p$ (side B), the mean B-side coefficient; calculate the difference between these two average values.

4.1.4.3 Calculate the deviation of each of the three A-side values of $C_{p(s)}$ from $\bar{C}_p$ (side A), and the deviation of each B-side value of $C_{p(s)}$ from $\bar{C}_p$ (side B). Use the following equation:

$$\text{Deviation} = C_{p(s)} - \bar{C}_p(\text{A or B})$$

Equation 2-3

4.1.4.4 Calculate σ, the average deviation from the mean, for both the A and B sides of the pitot tube. Use the following equation:

$$\sigma\,(\text{side A or B}) = \frac{\sum_{1}^{3} \left| C_{p(s)} - \bar{C}_p(A \text{ or } B) \right|}{3}$$

Equation 2-4

4.1.4.5 Use the Type S pitot tube only if the values of σ (side A) and σ (side B) are less than or equal to 0.01 and if the absolute value of the difference between $\bar{C}_p$ (A) and $\bar{C}_p$ (B) is 0.01 or less.

4.1.5 Special considerations.

4.1.5.1 Selection of calibration point.

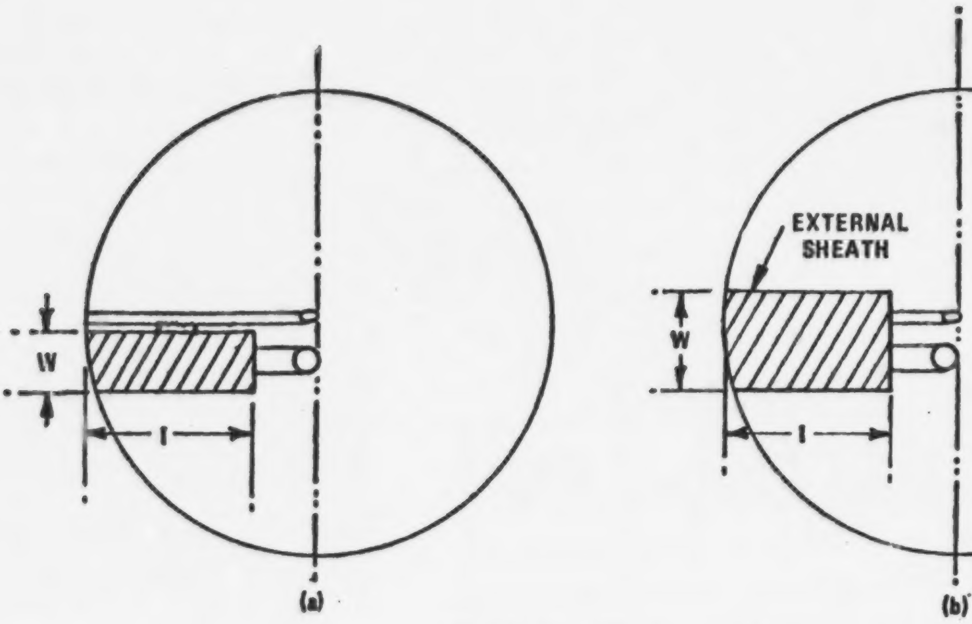
4.1.5.1.1 When an isolated Type S pitot tube is calibrated, select a calibration point at or near the center of the duct, and follow the procedures outlined in Sections 4.1.3 and 4.1.4 above. The Type S pitot coefficients so obtained, i.e., $\bar{C}_p$ (side A) and $\bar{C}_p$ (side B), will be valid, so long as either: (1) the isolated pitot tube is used; or (2) the pitot tube is used with other components (nozzle, thermocouple, sample probe) in an arrangement that is free from aerodynamic interference effects (see Figures 2-6 through 2-8).

4.1.5.1.2 For Type S pitot tube-thermocouple combinations (without sample probe), select a calibration point at or near the center of the duct, and follow the procedures outlined in Sections 4.1.3 and 4.1.4 above. The coefficients so obtained will be valid so long as the pitot tube-thermocouple combination is used by itself or with other components in an interference-free arrangement (Figures 2-6 and 2-8).

4.1.5.1.3 For assemblies with sample probes, the calibration point should be located at or near the center of the duct; however, insertion of a probe sheath into a small duct may cause significant cross-sectional area blockage and yield incorrect coefficient values (Citation 9 in Section 6). Therefore, to minimize the blockage effect, the calibration point may be a few inches off-center if necessary. The actual blockage effect will be negligible when the theoretical blockage, as determined by a projected-area model of the probe sheath, is 2 percent or less of the duct cross-sectional area for assemblies without external sheaths (Figure 2-10a), and 3 percent or less for assemblies with external sheaths (Figure 2-10b).

4.1.5.2 For those probe assemblies in which pitot tube-nozzle interference is a factor (i.e., those in which the pitot-nozzel separation distance fails to meet the specification illustrated in Figure 2-6a), the value of $C_{p(s)}$ depends upon the amount of free-space between the tube and nozzle, and therefore is a function of nozzle size. In these instances, separate calibrations shall be performed with each of the commonly used nozzle sizes in place. Note that the single-velocity calibration technique is acceptable for this purpose, even though the larger nozzle sizes (>0.635 cm or ¼ in.) are not ordinarily used for isokinetic sampling at velocities around 915 m/min (3,000 ft/min), which is the calibration velocity; note also that it is not necessary to draw an isokinetic sample during calibration (see Citation 19 in Section 6).

4.1.5.3 For a probe assembly constructed such that its pitot tube is always used in the same orientation, only one side of the pitot tube need be calibrated (the side which will face the flow). The pitot tube must still meet the alignment specifications of Figure 2-2 or 2-3, however, and must have an average deviation (σ) value of 0.01 or less (see Section 4.1.4.4).



$$\text{ESTIMATED SHEATH BLOCKAGE (\%)} = \left[\frac{l \times W}{\text{DUCT AREA}}\right] \times 100$$

Figure 2-10. Projected-area models for typical pitot tube assemblies.

4.1.6 Field Use and Recalibration.

4.1.6.1 Field Use.

4.1.6.1.1 When a Type S pitot tube (isolated tube or assembly) is used in the field, the appropriate coefficient value (whether assigned or obtained by calibration) shall be used to perform velocity calculations. For calibrated Type S pitot tubes, the A side coefficient shall be used when the A side of the tube faces the flow, and the B side coefficient shall be used when the B side faces the flow; alternatively, the arithmetic average of the A and B side coefficient values may be used, irrespective of which side faces the flow.

4.1.6.1.2 When a probe assembly is used to sample a small duct (12 to 36 in. in diameter), the probe sheath sometimes blocks a significant part of the duct cross-section, causing a reduction in the effective value of $\overline{C}_{p(s)}$. Consult Citation 9 in Section 6 for details. Conventional pitot-sampling probe assemblies are not recommended for use in ducts having inside diameters smaller than 12 inches (Citation 16 in Section 6).

4.1.6.2 Recalibration.

4.1.6.2.1 Isolated Pitot Tubes. After each field use, the pitot tube shall be carefully reexamined in top, side, and end views. If the pitot face openings are still aligned within the specifications illustrated in Figure 2-2 or 2-3, it can be assumed that the baseline coefficient of the pitot tube has not changed. If, however, the tube has been damaged to the extent that it no longer meets the specifications of Figure 2-2 or 2-3, the damage shall either be repaired to restore proper alignment of the face openings or the tube shall be discarded.

4.1.6.2.2 Pitot Tube Assemblies. After each field use, check the face opening alignment of the pitot tube, as in Section 4.1.6.2.1; also, remeasure the intercomponent spacings of the assembly. If the intercomponent spacings have not changed and the face opening alignment is acceptable, it can be assumed that the coefficient of the assembly has not changed. If the face opening alignment is no longer within the specifications of Figures 2-2 or 2-3, either repair the damage or replace the pitot tube (calibrating the new assembly, if necessary). If the intercomponent spacings have changed, restore the original spacings or recalibrate the assembly.

4.2 Standard pitot tube (if applicable). If a standard pitot tube is used for the velocity traverse, the tube shall be constructed according to the criteria of Section 2.7 and shall be assigned a baseline coefficient value of 0.99. If the standard pitot tube is used as part of an assembly, the tube shall be in an interference-free arrangement (subject to the approval of the Administrator).

4.3 Temperature Gauges. After each field use, calibrate dial thermometers, liquid-filled bulb thermometers, thermocouple-potentiometer systems, and other gauges at a temperature within 10 percent of the average absolute stack temperature. For temperatures up to 405° C (761° F), use an ASTM mercury-in-glass reference thermometer, or equivalent, as a reference; alternatively, either a reference thermocouple and potentiometer (calibrated by NBS) or thermometric fixed points, e.g., ice bath and boiling water (corrected for barometric pressure) may be used. For temperatures above 405° C (761° F), use an NBS-calibrated reference thermocouple-potentiometer system or an alternate reference, subject to the approval of the Administrator.

If, during calibration, the absolute temperatures measured with the gauge being calibrated and the reference gauge agree within 1.5 percent, the temperature data taken in the field shall be considered valid. Otherwise, the pollutant emission test shall either be considered invalid or adjustments (if appropriate) of the test results shall be made, subject to the approval of the Administrator.

4.4 Barometer. Calibrate the barometer used against a mercury barometer.

5. *Calculations*

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

5.1 Nomenclature.

A = Cross-sectional area of stack, m² (ft²).

B_{ws} = Water vapor in the gas stream (from Method 5 or Reference Method 4), proportion by volume.

C_p = Pitot tube coefficient, dimensionless.

K_p = Pitot tube constant,

$$34.97\ \frac{\text{m}}{\text{sec}}\left[\frac{(g/g\text{-mole})(\text{mm Hg})}{(^\circ\text{K})(\text{mm H}_2\text{O})}\right]^{1/2}$$

for the metric system and

$$85.49\ \frac{\text{ft}}{\text{sec}}\left[\frac{(\text{lb/lb-mole})(\text{in. Hg})}{(^\circ\text{R})(\text{in. H}_2\text{O})}\right]^{1/2}$$

for the English system.

M_d = Molecular weight of stack gas, dry basis (see Section 3.6) g/g-mole (lb/lb-mole).

M_s = Molecular weight of stack gas, wet basis, g/g-mole (lb/lb-mole).

$= M_d\,(1-B_{ws})+18.0\,B_{ws}$ Equation 2-5

P_{bar} = Barometric pressure at measurement site, mm Hg (in. Hg).

P_g = Stack static pressure, mm Hg (in. Hg).

P_s = Absolute stack gas pressure, mm Hg (in. Hg).

$= P_{bar}+P_g$ Equation 2-6

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

Q_{sd} = Dry volumetric stack gas flow rate corrected to standard conditions, dscm/hr (dscf/hr).

t_s = Stack temperature, °C (°F).

T_s = Absolute stack temperature, °K (°R).

$= 273+t_s$ for metric Equation 2-7

$= 460+t_s$ for English Equation 2-8

T_{std} = Standard absolute temperature, 293 °K (528° R)

v_s = Average stack gas velocity, m/sec (ft/sec).

Δp = Velocity head of stack gas, mm H₂O (in. H₂O).

3,600 = Conversion factor, sec/hr.

18.0 = Molecular weight of water, g/g-mole (lb-lb-mole).

5.2 Average stack gas velocity.

$$v_s = K_p C_p (\sqrt{\Delta p})_{avg} \sqrt{\frac{T_{s(avg)}}{P_s M_s}}$$

Equation 2-9

5.3 Average stack gas dry volumetric flow rate,

$$Q_{sd} = 3{,}600(1-B_{ws})v_s A\left(\frac{T_{std}}{T_{s\,(avg)}}\right)\left(\frac{P_s}{P_{std}}\right)$$

Equation 2-10

6. *Bibliography*

1. Mark, L. S. Mechanical Engineers' Handbook. New York, McGraw-Hill Book Co., Inc. 1951.

2. Perry, J. H. Chemical Engineers' Handbook. New York. McGraw-Hill Book Co., Inc. 1960.

3. Shigehara, R. T., W. F. Todd, and W. S. Smith. Significance of Errors in Stack Sampling Measurements. U.S. Environmental Protection Agency, Research Triangle Park, N.C. (Presented at the Annual Meeting of the Air Pollution Control Association, St. Louis, Mo., June 14-19, 1970.)

4. Standard Method for Sampling Stacks for Particulate Matter. In: 1971 Book of ASTM Standards, Part 23. Philadelphia, Pa. 1971. ASTM Designation D 2928-71.

5. Vennard, J. K. Elementary Fluid Mechanics. New York. John Wiley and Sons, Inc. 1947.

6. Fluid Meters—Their Theory and Application. American Society of Mechanical Engineers, New York, N.Y. 1959.

7. ASHRAE Handbook of Fundamentals. 1972. p. 208.

8. Annual Book of ASTM Standards, Part 26. 1974. p. 648.

9. Vollaro, R. F. Guidelines for Type S Pitot Tube Calibration. U.S. Environmental Protection Agency, Research Tiangle Park, N.C. (Presented at 1st Annual Meeting, Source Evaluation Society, Dayton, Ohio, September 18, 1975.)

10. Vollaro, R. F. A Type S Pitot Tube Calibration Study. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, N.C. July 1974.

11. Vollaro, R. F. The Effects of Impact Opening Misalignment on the Value of the Type S Pitot Tube Coefficient. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, N.C. October 1976.

12. Vollaro, R. F. Establishment of a Baseline Coefficient Value for Properly Constructed Type S Pitot Tubes. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, N.C. November 1976.

13. Vollaro, R. F. An Evaluation of Single-Velocity Calibration Techniques as a Means of Determining Type S Pitot Tube Coefficients. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, N.C. August 1975.

14. Vollaro, R. F. The Use of Type S Pitot Tubes for the Measurement of Low Velocities. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, N.C. November 1976.

15. Smith, Marvin L. Velocity Calibration of EPA Type Source Sampling Probe. United Technologies Corporation, Pratt and Whitney Aircraft Division, East Hartford, Conn. 1975.

16. Vollaro, R. F. Recommended Procedure for Sample Traverses in Ducts Smaller than 12 Inches in Diameter. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, N.C. November 1976.

17. Ower, E. and R. C. Pankhurst. The Measurement of Air Flow, 4th Ed., London, Pergamon Press. 1966.

18. Vollaro, R. F. A survey of Commercially Available Instrumentation for the Measurement of Low-Range Gas Velocities. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, N.C. November 1976. (Unpublished Paper)

19. Gnyp, A. W., C. C. St. Pierre, D. S. Smith, D. Mozzon, and J. Steiner. An Experimental Investigation of the Effect of Pitot Tube-Sampling Probe Configurations on the Magnitude of the S Type Pitot Tube Coefficient for Commercially Available Source Sampling Probes. Prepared by the University of Windsor for the Ministry of the Environment, Toronto, Canada. February 1975.

METHOD 3—GAS ANALYSIS FOR CARBON DIOXIDE, OXYGEN, EXCESS AIR, AND DRY MOLECULAR WEIGHT

1. *Principle and Applicability*

1.1 Principle. A gas sample is extracted from a stack, by one of the following methods: (1) single-point, grab sampling; (2) single-point, integrated sampling; or (3) multi-point, integrated sampling. The gas sample is analyzed for percent carbon dioxide (CO_2), percent oxygen (O_2), and, if necessary, percent carbon monoxide (CO). If a dry molecular weight determination is to be made, either an Orsat or a Fyrite[1] analyzer may be used for the analysis; for excess air or emission rate correction factor determination, an Orsat analyzer must be used.

1.3 Applicability. This method is applicable for determining CO_2 and O_2 concentrations, excess air, and dry molecular weight of a sample from a gas stream of a fossil-fuel combustion process. The method may also be applicable to other processes where it has been determined that compounds other than CO_2, O_2, CO, and nitrogen (N_2) are not present in concentrations sufficient to affect the results.

Other methods, as well as modifications to the procedure described herein, are also applicable for some or all of the above determinations. Examples of specific methods and modifications include: (1) a multi-point sampling method using an Orsat analyzer to analyze individual grab samples obtained at each point; (2) a method using CO_2 or O_2 and stoichiometric calculations to determine dry molecular weight and excess air; (3) assigning a value of 30.0 for dry molecular weight, in lieu of actual measurements, for processes burning natural gas, coal, or oil. These methods and modifications may be used, but are subject to the approval of the Administrator.

2. *Apparatus*

As an alternative to the sampling apparatus and systems described herein, other sampling systems (e.g., liquid displacement) may be used provided such systems are capable of obtaining a representative sample and maintaining a constant sampling rate, and are otherwise capable of yielding acceptable results. Use of such systems is subject to the approval of the Administrator.

2.1 Grab Sampling (Figure 3-1).

2.1.1 Probe. The probe should be made of stainless steel or borosilicate glass tubing and should be equipped with an in-stack or out-stack filter to remove particulate matter (a plug of glass wool is satisfactory for this purpose). Any other material inert to O_2, CO_2, CO, and N_2 and resistant to temperature at sampling conditions may be used for the probe; examples of such material are aluminum, copper, quartz glass and Teflon.

2.1.2 Pump. A one-way squeeze bulb, or equivalent, is used to transport the gas sample to the analyzer.

2.2 Integrated Sampling (Figure 3-2).

2.2.1 Probe. A probe such as that described in Section 2.1.1 is suitable.

2.2.2 Condenser. An air-cooled or water-cooled condenser, or other condenser that will not remove O_2, CO_2, CO, and N_2, may be used to remove excess moisture which would interfere with the operation of the pump and flow meter.

2.2.3 Valve. A needle valve is used to adjust sample gas flow rate.

2.2.4 Pump. A leak-free, diaphragm-type pump, or equivalent, is used to transport sample gas to the flexible bag. Install a small surge tank between the pump and rate meter to eliminate the pulsation effect of the diaphragm pump on the rotameter.

2.2.5 Rate Meter. The rotameter, or equivalent rate meter, used should be capable of measuring flow rate to within ±2 percent of the selected flow rate. A flow rate range of 500 to 1000 cm^3/min is suggested.

2.2.6 Flexible Bag. Any leak-free plastic (e.g., Tedlar, Mylar, Teflon) or plastic-coated aluminum (e.g., aluminized Mylar) bag, or equivalent, having a capacity consistent with the selected flow rate and time length of the test run, may be used. A capacity in the range of 55 to 90 liters is suggested.

To leak-check the bag, connect it to a water manometer and pressurize the bag to 5 to 10 cm H_2O (2 to 4 in. H_2O). Allow to stand for 10 minutes. Any displacement in the water manometer indicates a leak. An alternative leak-check method is to pressurize the bag to 5 to 10 cm H_2O (2 to 4 in. H_2O) and allow to stand overnight. A deflated bag indicates a leak.

2.2.7 Pressure Gauge. A water-filled U-tube manometer, or equivalent, of about 28 cm (12 in.) is used for the flexible bag leak-check.

2.2.8 Vacuum Gauge. A mercury manometer, or equivalent, of at least 760 mm Hg (30 in. Hg) is used for the sampling train leak-check.

2.3 Analysis. For Orsat and Fyrite analyzer maintenance and operation procedures, follow the instructions recommended by the manufacturer, unless otherwise specified herein.

2.3.1 Dry Molecular Weight Determination. An Orsat analyzer or Fyrite type combustion gas analyzer may be used.

2.3.2 Emission Rate Correction Factor or Excess Air Determination. An Orsat analyzer must be used. For low CO_2 (less than 4.0 percent) or high O_2 (greater than 15.0 percent) concentrations, the measuring burette of the Orsat must have at least 0.1 percent subdivisions.

3. *Dry Molecular Weight Determination*

Any of the three sampling and analytical procedures described below may be used for determining the dry molecular weight.

3.1 Single-Point, Grab Sampling and Analytical Procedure.

3.1.1 The sampling point in the duct shall either be at the centroid of the cross section or at a point no closer to the walls than 1.00 m (3.3 ft), unless otherwise specified by the Administrator.

3.1.2 Set up the equipment as shown in Figure 3-1, making sure all connections ahead of the analyzer are tight and leak-free. If an Orsat analyzer is used, it is recommended that the analyzer be leaked-checked by following the procedure in Section 5; however, the leak-check is optional.

3.1.3 Place the probe in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Draw a sample into the analyzer and immediately analyze it for percent CO_2 and percent O_2. Determine the percentage of the gas that is N_2 and CO by subtracting the sum of the percent CO_2 and percent O_2 from 100 percent. Calculate the dry molecular weight as indicated in Section 6.3.

3.1.4 Repeat the sampling, analysis, and calculation procedures, until the dry molecular weights of any three grab samples differ from their mean by no more than 0.3 g/g-mole (0.3 lb/lb-mole). Average these three molecular weights, and report the results to the nearest 0.1 g/g-mole (lb/lb-mole).

3.2 Single-Point, Integrated Sampling and Analytical Procedure.

3.2.1 The sampling point in the duct shall be located as specified in Section 3.1.1.

3.2.2 Leak-check (optional) the flexible bag as in Section 2.2.6. Set up the equipment as shown in Figure 3-2. Just prior to sampling, leak-check (optional) the train by placing a vacuum gauge at the condenser inlet, pulling a vacuum of at least 250 mm Hg (10 in. Hg), plugging the outlet at the quick disconnect, and then turning off the pump. The vacuum should remain stable for at least 0.5 minute. Evacuate the flexible bag. Connect the probe and place it in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Next, connect the bag and make sure that all connections are tight and leak free.

3.2.3 Sample at a constant rate. The sampling run should be simultaneous with, and for the same total length of time as, the pollutant emission rate determination. Collection of at least 30 liters (1.00 ft^3) of sample gas is recommended; however, smaller volumes may be collected, if desired.

3.2.4 Obtain one integrated flue gas sample during each pollutant emission rate determination. Within 8 hours after the sample is taken, analyze it for percent CO_2 and percent O_2 using either an Orsat analyzer or a Fyrite-type combustion gas analyzer. If an Orsat analyzer is used, it is recommended that the Orsat leak-check described in Section 5 be performed before this determination; however, the check is optional. Determine the percentage of the gas that is N_2 and CO by subtracting the sum of the percent CO_2 and percent O_2 from 100 percent. Calculate the dry molecular weight as indicated in Section 6.2.

---

[1] Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

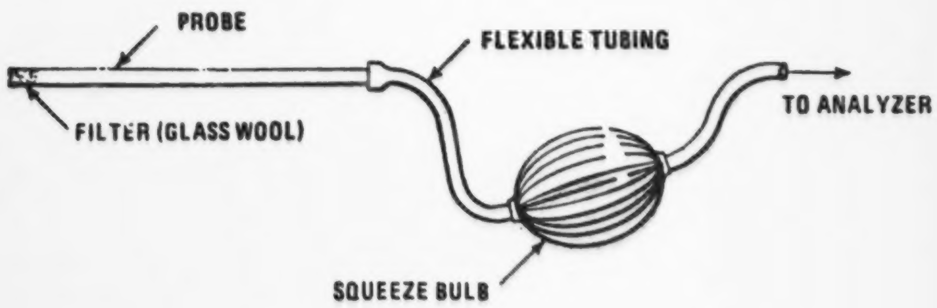


Figure 3-1. Grab-sampling train.

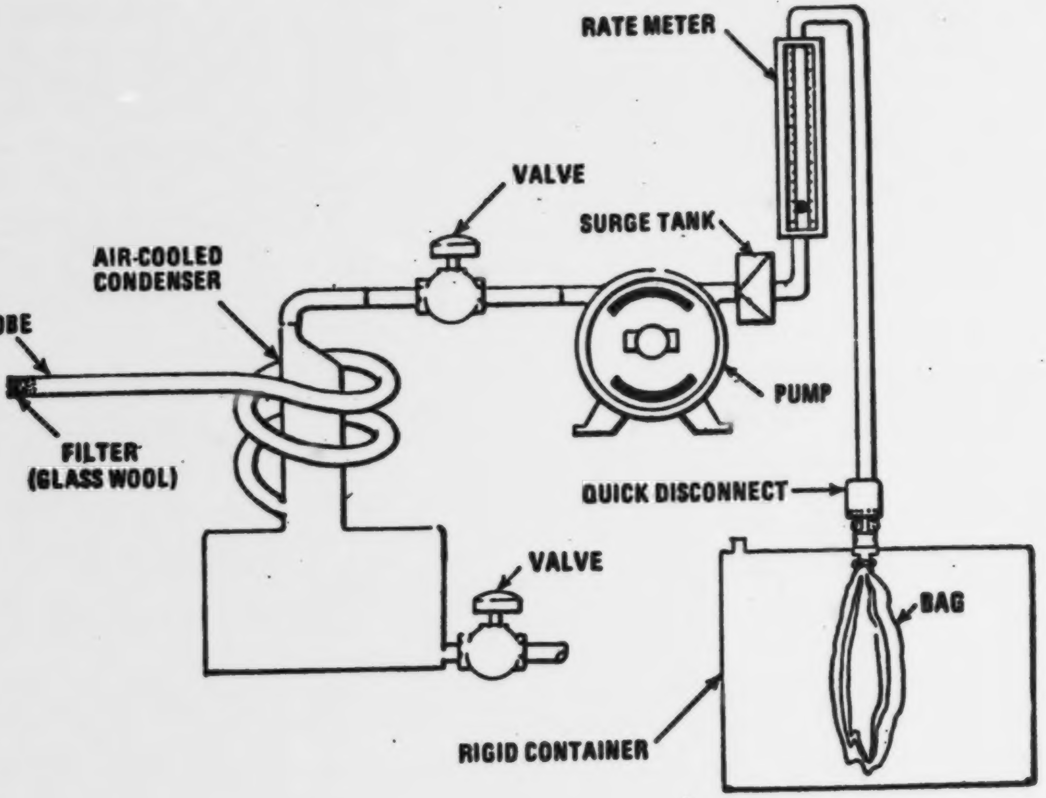

RATE METER
VALVE
SURGE TANK
AIR-COOLED CONDENSER
PROBE
PUMP
FILTER (GLASS WOOL)
QUICK DISCONNECT
VALVE
BAG
RIGID CONTAINER

Figure 3-2. Integrated gas-sampling train.

TIME	TRAVERSE PT.	Q lpm	% DEV.[a]
	AVERAGE		

[a] $\% \text{ DEV} = \left(\frac{Q - Q\text{ avg}}{Q\text{ avg}}\right) 100$ (MUST BE $<$10%)

Figure 3-3. Sampling rate data.

3.2.5 Repeat the analysis and calculation procedures until the individual dry molecular weights for any three analyses differ from their mean by no more than 0.3 g/g-mole (0.3 lb/lb-mole). Average these three molecular weights, and report the results to the nearest 0.1 g/g-mole (0.1 lb/lb-mole).

3.3 Multi-Point, Integrated Sampling and Analytical Procedure.

3.3.1 Unless otherwise specified by the Administrator, a minimum of eight traverse points shall be used for circular stacks having diameters less then 0.61 m (24 in.), a minimum of nine shall be used for rectangular stacks having equivalent diameters less than 0.61 m (24 in.), and a minimum of twelve traverse points shall be used for all other cases. The traverse points shall be located according to Method 1. The use of fewer points is subject to approval of the Administrator.

3.3.2 Follow the procedures outlined in Sections 3.2.2 through 3.2.5, except for the following: traverse all sampling points and sample at each point for an equal length of time. Record sampling data as shown in Figure 3-3.

4. *Emission Rate Correction Factor or Excess Air Determination*

NOTE.—A Fyrite-type combustion gas analyzer is not acceptable for excess air or emission rate correction factor determination, unless approved by the Administrator. If both percent CO_2 and percent O_2 are measured, the analytical results of any of the three procedures given below may also be used for calculating the dry molecular weight.

Each of the three procedures below shall be used only when specified in an applicable subpart of the standards. The use of these procedures for other purposes must have specific prior approval of the Administrator.

4.1 Single-Point, Grab Sampling and Analytical Procedure.

4.1.1 The sampling point in the duct shall either be at the centroid of the cross-section or at a point no closer to the walls than 1.00 m (3.3 ft), unless otherwise specified by the Administrator.

4.1.2 Set up the equipment as shown in Figure 3-1, making sure all connections ahead of the analyzer are tight and leak-free. Leak-check the Orsat analyzer according to the procedure described in Section 5. This leak-check is mandatory.

4.1.3 Place the probe in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Draw a sample into the analyzer. For emission rate correction factor determination, immediately analyze the sample, as outlined in Sections 4.1.4 and 4.1.5, for percent CO_2 or percent O_2. If excess air is desired, proceed as follows: (1) immediately analyze the sample, as in Sections 4.1.4 and 4.1.5, for percent CO_2, O_2, and CO; (2) determine the percentage of the gas that is N_2 by subtracting the sum of the percent CO_2, percent O_2, and percent CO from 100 percent; and (3) calculate percent excess air as outlined in Section 6.2.

4.1.4 To ensure complete absorption of the CO_2, O_2, or if applicable, CO, make repeated passes through each absorbing solution until two consecutive readings are the same. Several passes (three or four) should be made between readings. (If constant readings cannot be obtained after three consecutive readings, replace the absorbing solution.)

4.1.5 After the analysis is completed, leak-check (mandatory) the Orsat analyzer once again, as described in Section 5. For the results of the analysis to be valid, the Orsat analyzer must pass this leak test before and after the analysis. NOTE.—Since this single-point, grab sampling and analytical procedure is normally conducted in conjunction with a single-point, grab sampling and analytical procedure for a pollutant, only one analysis is ordinarily conducted. Therefore, great care must be taken to obtain a valid sample and analysis. Although in most cases only CO_2 or O_2 is required, it is recommended that both CO_2 and O_2 be measured, and that Citation 5 in the Bibliography be used to validate the analytical data.

4.2 Single-Point, Integrated Sampling and Analytical Procedure.

4.2.1 The sampling point in the duct shall be located as specified in Section 4.1.1.

4.2.2 Leak-check (mandatory) the flexible bag as in Section 2.2.6. Set up the equipment as shown in Figure 3-2. Just prior to sampling, leak-check (mandatory) the train by placing a vacuum gauge at the condenser inlet, pulling a vacuum of at least 250 mm Hg (10 in. Hg), plugging the outlet at the quick disconnect, and then turning off the pump. The vacuum shall remain stable for at least 0.5 minute. Evacuate the flexible bag. Connect the probe and place it in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Next, connect the bag and make sure that all connections are tight and leak free.

4.2.3 Sample at a constant rate, or as specified by the Administrator. The sampling run must be simultaneous with, and for the same total length of time as, the pollutant emission rate determination. Collect at least 30 liters (1.00 ft³) of sample gas. Smaller volumes may be collected, subject to approval of the Administrator.

4.2.4 Obtain one integrated flue gas sample during each pollutant emission rate determination. For emission rate correction factor determination, analyze the sample within 4 hours after it is taken for percent CO_2 or percent O_2 (as outlined in Sections 4.2.5 through 4.2.7). The Orsat analyzer must be leak-checked (see Section 5) before the analysis. If excess air is desired, proceed as follows: (1) within 4 hours after the sample is taken, analyze it (as in Sections 4.2.5 through 4.2.7) for percent CO_2, O_2, and CO; (2) determine the percentage of the gas that is N_2 by subtracting the sum of the percent CO_2, percent O_2, and percent CO from 100 percent; (3) calculate percent excess air, as outlined in Section 6.2.

4.2.5 To ensure complete absorption of the CO_2, O_2, or if applicable, CO, make repeated passes through each absorbing solution until two consecutive readings are the same. Several passes (three or four) should be made between readings. (If constant readings cannot be obtained after three consecutive readings, replace the absorbing solution.)

4.2.6 Repeat the analysis until the following criteria are met:

4.2.6.1 For percent CO_2, repeat the analytical procedure until the results of any three analyses differ by no more than (a) 0.3 percent by volume when CO_2 is greater than 4.0 percent or (b) 0.2 percent by volume when CO_2 is less than or equal to 4.0 percent. Average the three acceptable values of percent CO_2 and report the results to the nearest 0.1 percent.

4.2.6.2 For percent O_2, repeat the analytical procedure until the results of any three analyses differ by no more than (a) 0.3 percent by volume when O_2 is less than 15.0 percent or (b) 0.2 percent by volume when O_2 is greater than 15.0 percent. Average the three acceptable values of percent O_2 and report the results to the nearest 0.1 percent.

4.2.6.3 For percent CO, repeat the analytical procedure until the results of any three analyses differ by no more than 0.3 percent. Average the three acceptable values of percent CO and report the results to the nearest 0.1 percent.

4.2.7 After the analysis is completed, leak-check (mandatory) the Orsat analyzer once again, as described in Section 5. For the results of the analysis to be valid, the Orsat analyzer must pass this leak test before and after the analysis. Note: Although in most instances only CO_2 or O_2 is required, it is recommended that both CO_2 and O_2 be measured, and that Citation 5 in the Bibliography be used to validate the analytical data.

4.3 Multi-Point, Integrated Sampling and Analytical Procedure.

4.3.1 Both the minimum number of sampling points and the sampling point location shall be as specified in Section 3.3.1 of this method. The use of fewer points than specified is subject to the approval of the Administrator.

4.3.2 Follow the procedures outlined in Sections 4.2.2 through 4.2.7, except for the following: Traverse all sampling points and sample at each point for an equal length of time. Record sampling data as shown in Figure 3-3.

5. *Leak-Check Procedure for Orsat Analyzers*

Moving an Orsat analyzer frequently causes it to leak. Therefore, an Orsat analyzer should be thoroughly leak-checked on site before the flue gas sample is introduced into it. The procedure for leak-checking an Orsat analyzer is:

5.1.1 Bring the liquid level in each pipette up to the reference mark on the capillary tubing and then close the pipette stopcock.

5.1.2 Raise the leveling bulb sufficiently to bring the confining liquid meniscus onto the graduated portion of the burette and then close the manifold stopcock.

5.1.3 Record the meniscus position.

5.1.4 Observe the meniscus in the burette and the liquid level in the pipette for movement over the next 4 minutes.

5.1.5 For the Orsat analyzer to pass the leak-check, two conditions must be met.

5.1.5.1 The liquid level in each pipette must not fall below the bottom of the capillary tubing during this 4-minute interval.

5.1.5.2 The meniscus in the burette must not change by more than 0.2 ml during this 4-minute interval.

5.1.6 If the analyzer fails the leak-check procedure, all rubber connections and stopcocks should be checked until the cause of the leak is identified. Leaking stopcocks must be disassembled, cleaned, and regreased. Leaking rubber connections must be replaced. After the analyzer is reassembled, the leak-check procedure must be repeated.

6. *Calculations*

6.1 Nomenclature.

M_d = Dry molecular weight, g/g-mole (lb/lb-mole).
%EA = Percent excess air.
$\%CO_2$ = Percent CO_2 by volume (dry basis).
$\%O_2$ = Percent O_2 by volume (dry basis).
%CO = Percent CO by volume (dry basis).
$\%N_2$ = Percent N_2 by volume (dry basis).
0.264 = Ratio of O_2 to N_2 in air, v/v.
0.280 = Molecular weight of N_2 or CO, divided by 100.
0.320 = Molecular weight of O_2 divided by 100.
0.440 = Molecular weight of CO_2 divided by 100.

6.2 Percent Excess Air. Calculate the percent excess air (if applicable), by substituting the appropriate values of percent O_2, CO, and N_2 (obtained from Section 4.1.3 or 4.2.4) into Equation 3-1.

$$\%EA = \left[\frac{\%O_2 - 0.5\%CO}{0.264\,\%N_2\,(\%O_2 - 0.5\,\%CO)}\right]100$$

Equation 3-1

NOTE.—The equation above assumes that ambient air is used as the source of O_2 and that the fuel does not contain appreciable amounts of N_2 (as do coke oven or blast furnace gases). For those cases when appreciable amounts of N_2 are present (coal, oil, and natural gas do not contain appreciable amounts of N_2) or when oxygen enrichment is used, alternate methods, subject to approval of the Administrator, are required.

6.3 Dry Molecular Weight. Use Equation 3-2 to calculate the dry molecular weight of the stack gas

$$M_d = 0.440(\%CO_2) + 0.320(\%O_2) + 0.280(\%N_2 + \%CO)$$

Equation 3-2

NOTE.—The above equation does not consider argon in air (about 0.9 percent, molecular weight of 37.7). A negative error of about 0.4 percent is introduced. The tester may opt to include argon in the analysis using procedures subject to approval of the Administrator.

7. *Bibliography*

1. Altshuller, A. P. Storage of Gases and Vapors in Plastic Bags. International Journal of Air and Water Pollution. 6:75-81. 1963.

2. Conner, William D. and J. S. Nader. Air Sampling Plastic Bags. Journal of the American Industrial Hygiene Association. 25:291-297. 1964.

3. Burrell Manual for Gas Analysts, Seventh edition. Burrell Corporation, 2223 Fifth Avenue, Pittsburgh, Pa. 15219. 1951.

4. Mitchell, W. J. and M. R. Midgett. Field Reliability of the Orsat Analyzer. Journal of Air Pollution Control Association 26:491-495. May 1976.

5. Shigehara, R. T., R. M. Neulicht, and W. S. Smith. Validating Orsat Analysis Data from Fossil Fuel-Fired Units. Stack Sampling News. 4(2):21-26. August, 1976.

METHOD 4—DETERMINATION OF MOISTURE CONTENT IN STACK GASES

1. *Principle and Applicability*

1.1 Principle. A gas sample is extracted at a constant rate from the source; moisture is removed from the sample stream and determined either volumetrically or gravimetrically.

1.2 Applicability. This method is applicable for determining the moisture content of stack gas.

Two procedures are given. The first is a reference method, for accurate determinations of moisture content (such as are needed to calculate emission data). The second is an approximation method, which provides estimates of percent moisture to aid in setting isokinetic sampling rates prior to a pollutant emission measurement run. The approximation method described herein is only a suggested approach; alternative means for approximating the moisture content, e.g., drying tubes, wet bulb-dry bulb techniques, condensation techniques, stoichiometric calculations, previous experience, etc., are also acceptable.

The reference method is often conducted simultaneously with a pollutant emission measurement run; when it is, calculation of percent isokinetic, pollutant emission rate, etc., for the run shall be based upon the results of the reference method or its equivalent; these calculations shall not be based upon the results of the approximation method, unless the approximation method is shown, to the satisfaction of the Administrator, U.S. Environmental Protection Agency, to be capable of yielding results within 1 percent H_2O of the reference method.

NOTE.—The reference method may yield questionable results when applied to saturated gas streams or to streams that contain water droplets. Therefore, when these conditions exist or are suspected, a second determination of the moisture content shall be made simultaneously with the reference method, as follows: Assume that the gas stream is saturated. Attach a temperature sensor [capable of measuring to ±1° C (2° F)] to the reference method probe. Measure the stack gas temperature at each traverse point (see Section 2.2.1) during the reference method traverse; calculate the average stack gas temperature. Next, determine the moisture percentage, either by: (1) using a psychrometric chart and making appropriate corrections if stack pressure is different from that of the chart, or (2) using saturation vapor pressure tables. In cases where the psychrometric chart or the saturation vapor pressure tables are not applicable (based on evaluation of the process), alternate methods, subject to the approval of the Administrator, shall be used.

2. *Reference Method*

The procedure described in Method 5 for determining moisture content is acceptable as a reference method.

2.1 Apparatus. A schematic of the sampling train used in this reference method is shown in Figure 4-1. All components shall be maintained and calibrated according to the procedure outlined in Method 5.

2.1.1 Probe. The probe is constructed of stainless steel or glass tubing, sufficiently heated to prevent water condensation, and is equipped with a filter, either in-stack (e.g., a plug of glass wool inserted into the end of the probe) or heated out-stack (e.g., as described in Method 5), to remove particulate matter.

When stack conditions permit, other metals or plastic tubing may be used for the probe, subject to the approval of the Administrator.

2.1.2 Condenser. The condenser consists of four impingers connected in series with ground glass, leak-free fittings or any similarly leak-free non-contaminating fittings. The first, third, and fourth impingers shall be of the Greenburg-Smith design, modified by replacing the tip with a 1.3 centimeter (½ inch) ID glass tube extending to about 1.3 cm (½ in.) from the bottom of the flask. The second impinger shall be of the Greenburg-Smith design with the standard tip. Modifications (e.g., using flexible connections between the impingers, using materials other than glass, or using flexible vacuum lines to connect the filter holder to the condenser) may be used, subject to the approval of the Administrator.

The first two impingers shall contain known volumes of water, the third shall be empty, and the fourth shall contain a known weight of 6- to 16-mesh indicating type silica gel, or equivalent desiccant. If the silica gel has been previously used, dry at 175° C (350° F) for 2 hours. New silica gel may be used as received. A thermometer, capable of measuring temperature to within 1° C (2° F), shall be placed at the outlet of the fourth impinger, for monitoring purposes.

Alternatively, any system may be used (subject to the approval of the Administrator) that cools the sample gas stream and allows measurement of both the water that has been condensed and the moisture leaving the condenser, each to within 1 ml or 1 g. Acceptable means are to measure the condensed water, either gravimetrically or volumetrically, and to measure the moisture leaving the condenser by: (1) monitoring the temperature and pressure at the exit of the condenser and using Dalton's law of partial pressures, or (2) passing the sample gas stream through a tared silica gel (or equivalent desiccant) trap, with exit gases kept below 20° C (68° F), and determining the weight gain.

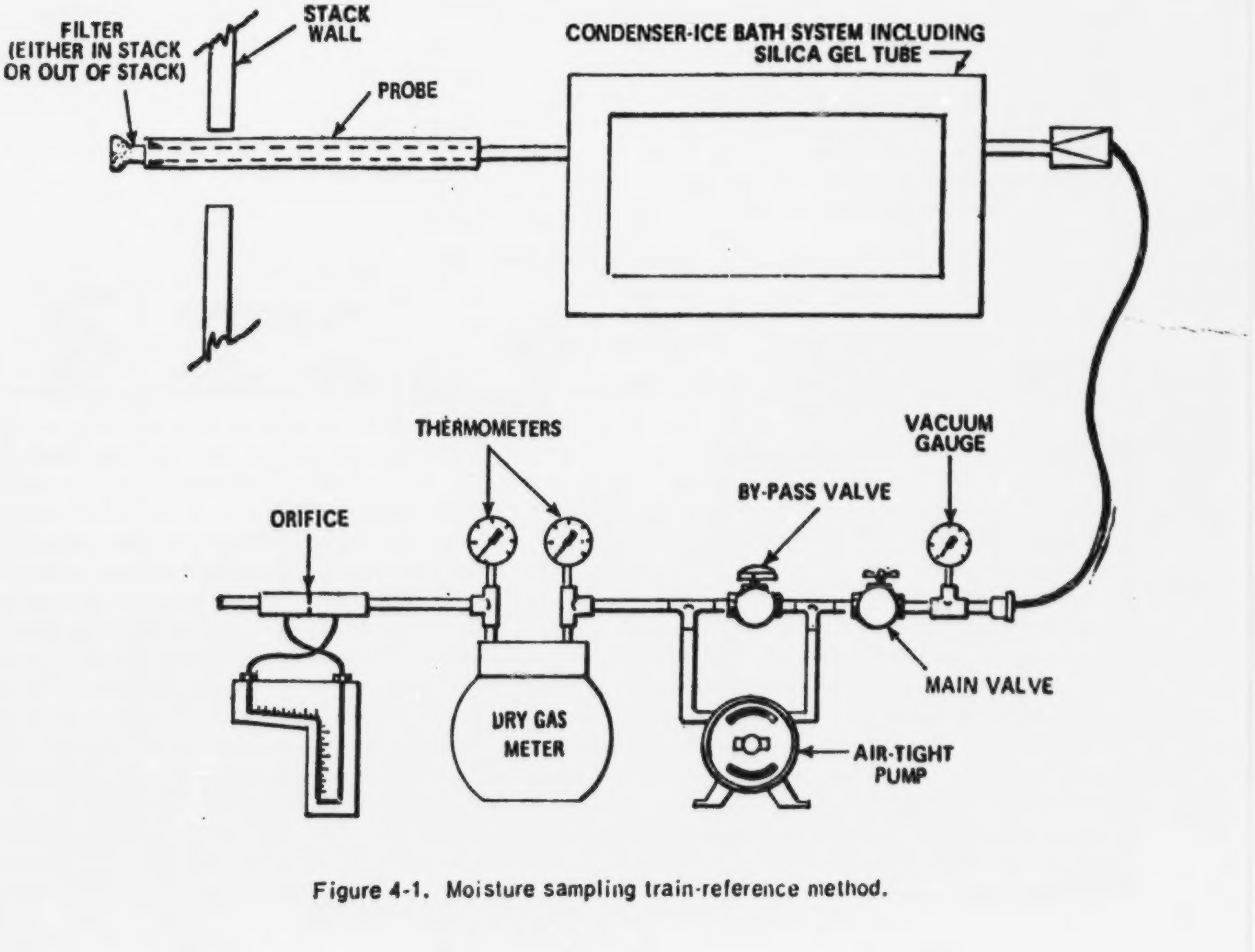


Figure 4-1. Moisture sampling train-reference method.

If means other than silica gel are used to determine the amount of moisture leaving the condenser, it is recommended that silica gel (or equivalent) still be used between the condenser system and pump, to prevent moisture condensation in the pump and metering devices and to avoid the need to make corrections for moisture in the metered volume.

2.1.3 Cooling System. An ice bath container and crushed ice (or equivalent) are used to aid in condensing moisture.

2.1.4 Metering System. This system includes a vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3° C (5.4° F), dry gas meter capable of measuring volume to within 2 percent, and related equipment as shown in Figure 4-1. Other metering systems, capable of maintaining a constant sampling rate and determining sample gas volume, may be used, subject to the approval of the Administrator.

2.1.5 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg) may be used. In many cases, the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and the sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase or vice versa for elevation decrease.

2.1.6 Graduated Cylinder and/or Balance. These items are used to measure condensed water and moisture caught in the silica gel to within 1 ml or 0.5 g. Graduated cylinders shall have subdivisions no greater than 2 ml. Most laboratory balances are capable of weighing to the nearest 0.5 g or less. These balances are suitable for use here.

2.2 Procedure. The following procedure is written for a condenser system (such as the impinger system described in Section 2.1.2) incorporating volumetric analysis to measure the condensed moisture, and silica gel and gravimetric analysis to measure the moisture leaving the condenser.

2.2.1 Unless otherwise specified by the Administrator, a minimum of eight traverse points shall be used for circular stacks having diameters less than 0.61 m (24 in.), a minimum of nine points shall be used for rectangular stacks having equivalent diameters less than 0.61 m (24 in.), and a minimum of twelve travers points shall be used in all other cases. The traverse points shall be located according to Method 1. The use of fewer points is subject to the approval of the Administrator. Select a suitable probe and probe length such that all traverse points can be sampled. Consider sampling from opposite sides of the stack (four total sampling ports) for large stacks, to permit use of shorter probe lengths. Mark the probe with heat resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point. Place known volumes of water in the first two impingers. Weigh and record the weight of the silica gel to the nearest 0.5 g, and transfer the silica gel to the fourth impinger; alternatively, the silica gel may first be transferred to the impinger, and the weight of the silica gel plus impinger recorded.

2.2.2 Select a total sampling time such that a minimum total gas volume of 0.60 scm (21 scf) will be collected, at a rate no greater than 0.021 m³/min (0.75 cfm). When both moisture content and pollutant emission rate are to be determined, the moisture determination shall be simultaneous with, and for the same total length of time as, the pollutant emission rate run, unless otherwise specified in an applicable subpart of the standards.

2.2.3 Set up the sampling train as shown in Figure 4-1. Turn on the probe heater and (if applicable) the filter heating system to temperatures of about 120° C (248° F), to prevent water condensation ahead of the condenser; allow time for the temperatures to stabilize. Place crushed ice in the ice bath container. It is recommended, but not required, that a leak check be done, as follows: Disconnect the probe from the first impinger or (if applicable) from the filter holder. Plug the inlet to the first impinger (or filter holder) and pull a 380 mm (15 in.) Hg vacuum; a lower vacuum may be used, provided that it is not exceeded during the test. A leakage rate in excess of 4 percent of the average sampling rate or 0.00057 m³/min (0.02 cfm), whichever is less, is unacceptable. Following the leak check, reconnect the probe to the sampling train.

2.2.4 During the sampling run, maintain a sampling rate within 10 percent of constant rate, or as specified by the Administrator. For each run, record the data required on the example data sheet shown in Figure 4-2. Be sure to record the dry gas meter reading at the beginning and end of each sampling time increment and whenever sampling is halted. Take other appropriate readings at each sample point, at least once during each time increment.

2.2.5 To begin sampling, position the probe tip at the first traverse point. Immediately start the pump and adjust the flow to the desired rate. Traverse the cross section, sampling at each traverse point for an equal length of time. Add more ice and, if necessary, salt to maintain a temperature of less than 20° C (68° F) at the silica gel outlet.

2.2.6 After collecting the sample, disconnect the probe from the filter holder (or from the first impinger) and conduct a leak check (mandatory) as described in Section 2.2.3. Record the leak rate. If the leakage rate exceeds the allowable rate, the tester shall either reject the test results or shall correct the sample volume as in Section 6.3 of Method 5. Next, measure the volume of the moisture condensed to the nearest ml. Determine the increase in weight of the silica gel (or silica gel plus impinger) to the nearest 0.5 g. Record this information (see example data sheet, Figure 4-3) and calculate the moisture percentage, as described in 2.3 below.

PLANT______________________________
LOCATION____________________________
OPERATOR____________________________
DATE________________________________
RUN NO._____________________________
AMBIENT TEMPERATURE____________________
BAROMETRIC PRESSURE____________________
PROBE LENGTH m(ft)_____________________

SCHEMATIC OF STACK CROSS SECTION

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STACK TEMPERATURE °C (°F)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH), mm(in.) H_2O	METER READING GAS SAMPLE VOLUME m^3 (ft^3)	ΔV_m m^3 (ft^3)	GAS SAMPLE TEMPERATURE AT DRY GAS METER		TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, °C (°F)
						INLET ($T_{m_{in}}$), °C (°F)	OUTLET ($T_{m_{out}}$), °C (°F)	
TOTAL						Avg.	Avg.	
AVERAGE						Avg.		

Figure 4-2. Field moisture determination-reference method.

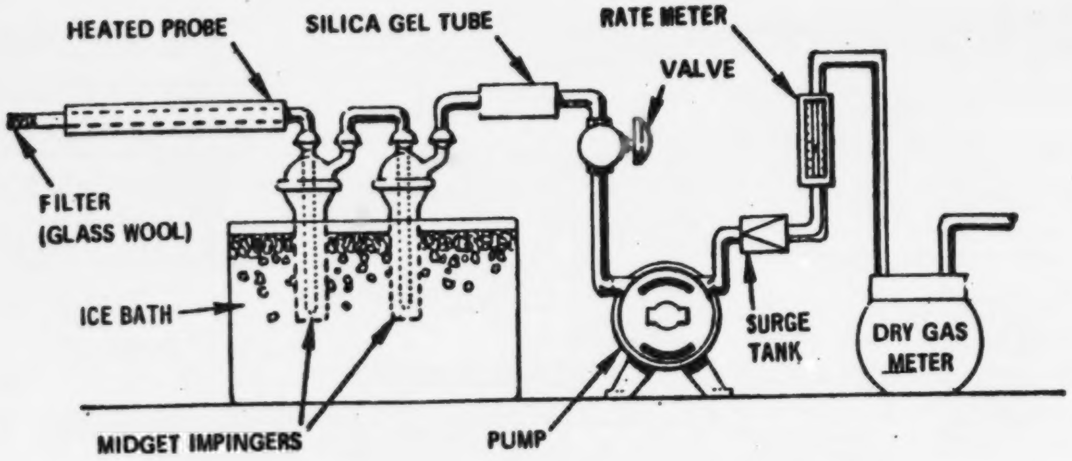

HEATED PROBE
SILICA GEL TUBE
RATE METER
VALVE
FILTER (GLASS WOOL)
ICE BATH
SURGE TANK
DRY GAS METER
MIDGET IMPINGERS
PUMP

Figure 4-4. Moisture-sampling train - approximation method.

LOCATION ______________________ COMMENTS

TEST ______________________

DATE ______________________

OPERATOR ______________________

BAROMETRIC PRESSURE ______________________

CLOCK TIME	GAS VOLUME THROUGH METER, (Vm), m^3 (ft^3)	RATE METER SETTING m^3/min. (ft^3/min.)	METER TEMPERATURE, °C (°F)

Figure 4-5. Field moisture determination - approximation method.

2.3 Calculations. Carry out the following calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
FINAL		
INITIAL		
DIFFERENCE		

Figure 4-3. Analytical data - reference method.

2.3.1 Nomenclature.

B_{ws} = Proportion of water vapor, by volume, in the gas stream.

M_w = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).

P_m = Absolute pressure (for this method, same as barometric pressure) at the dry gas meter, mm Hg (in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

R = Ideal gas constant, 0.06236 (mm Hg) (m^3)/(g-mole) (°K) for metric units and 21.85 (in. Hg) (ft^3)/(lb-mole) (°R) for English units.

T_m = Absolute temperature at meter, °K (°R).

T_{std} = Standard absolute temperature, 293° K (528° R).

V_m = Dry gas volume measured by dry gas meter, dcm (dcf).

ΔV_m = Incremental dry gas volume measured by dry gas meter at each traverse point, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

$V_{wc(std)}$ = Volume of water vapor condensed corrected to standard conditions, scm (scf).

$V_{wsg(std)}$ = Volume of water vapor collected in silica gel corrected to standard conditions, scm (scf).

V_f = Final volume of condenser water, ml.

V_i = Initial volume, if any, of condenser water, ml.

W_f = Final weight of silica gel or silica gel plus impinger, g.

W_i = Initial weight of silica gel or silica gel plus impinger, g.

Y = Dry gas meter calibration factor.

ρ_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).

2.3.2 Volume of water vapor condensed.

$$V_{wc(std)} = \frac{(V_f - V_i)\rho_w R T_{std}}{P_{std} M_w} = K_1 (V_f - V_i)$$

Equation 4-1

where:

K_1 = 0.001333 m^3/ml for metric units

= 0.04707 ft^3/ml for English units

2.3.3 Volume of water vapor collected in silica gel.

$$V_{wsg(std)} = \frac{(W_f - W_i) R T_{std}}{P_{std} M_w} = K_2 (W_f - W_i)$$

Equation 4-2

where:

K_2 = 0.001335 m^3/g for metric units

= 0.04715 ft^3/g for English units

2.3.4 Sample gas volume.

$$V_{m(std)} = V_m Y \frac{(P_m)(T_{std})}{(P_{std})(T_m)} = K_3 Y \frac{V_m P_m}{T_m}$$

Equation 4-3

where:

K_3 = 0.3858 °K/mm Hg for metric units

= 17.64 °R/in. Hg for English units

NOTE.—If the post-test leak rate (Section 2.2.6) exceeds the allowable rate, correct the value of V_m in Equation 4-3, as described in Section 6.3 of Method 5.

2.3.5 Moisture Content.

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}}$$

Equation 4-4

NOTE.—In saturated or moisture droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one using a value based upon the saturated conditions (see Section 1.2), and another based upon the results of the impinger analysis. The lower of these two values of B_{ws} shall be considered correct.

2.3.6 Verification of constant sampling rate. For each time increment, determine the ΔV_m. Calculate the average. If the value for any time increment differs from the average by more than 10 percent, reject the results and repeat the run.

3. *Approximation Method*

The approximation method described below is presented only as a suggested method (see Section 1.2).

3.1 Apparatus.

3.1.1 Probe. Stainless steel or glass tubing, sufficiently heated to prevent water condensation and equipped with a filter (either in-stack or heated out-stack) to remove particulate matter. A plug of glass wool, inserted into the end of the probe, is a satisfactory filter.

3.1.2 Impingers. Two midget impingers, each with 30 ml capacity, or equivalent.

3.1.3 Ice Bath. Container and ice, to aid in condensing moisture in impingers.

3.1.4 Drying Tube. Tube packed with new or regenerated 6- to 16-mesh indicating-type silica gel (or equivalent desiccant), to dry the sample gas and to protect the meter and pump.

3.1.5 Valve. Needle va [illegible] o regulate the sample gas flow rate.

3.1.6 Pump. Leak-free, diaphragm type, or equivalent, to pull the gas sample through the train.

3.1.7 Volume meter. Dry gas meter, sufficiently accurate to measure the sample volume within 2%, and calibrated over the range of flow rates and conditions actually encountered during sampling.

3.1.8 Rate Meter. Rotameter, to measure the flow range from 0 to 3 lpm (0 to 0.11 cfm).

3.1.9 Graduated Cylinder. 25 ml.

3.1.10 Barometer. Mercury, aneroid, or other barometer, as described in Section 2.1.5 above.

3.1.11 Vacuum Gauge. At least 760 mm Hg (30 in. Hg) gauge, to be used for the sampling leak check.

3.2 Procedure.

3.2.1 Place exactly 5 ml distilled water in each impinger. Assemble the apparatus without the probe as shown in Figure 4-4. Leak check the train by placing a vacuum gauge at the inlet to the first impinger and drawing a vacuum of at least 250 mm Hg (10 in. Hg), plugging the outlet of the rotameter, and then turning off the pump. The vacuum shall remain constant for at least one minute. Carefully release the vacuum gauge before unplugging the rotameter end.

3.2.2 Connect the probe, insert it into the stack, and sample at a constant rate of 2 lpm (0.071 cfm). Continue sampling until the dry gas meter registers about 30 liters (1.1 ft^3) or until visible liquid droplets are carried over from the first impinger to the second. Record temperature, pressure, and dry gas meter readings as required by Figure 4-5.

3.2.3 After collecting the sample, combine the contents of the two impingers and measure the volume to the nearest 0.5 ml.

3.3 Calculations. The calculation method presented is designed to estimate the moisture in the stack gas; therefore, other data, which are only necessary for accurate moisture determinations, are not collected. The following equations adequately estimate the moisture content, for the purpose of determining isokinetic sampling rate settings.

3.3.1 Nomenclature.

B_{wm} = Approximate proportion, by volume, of water vapor in the gas stream leaving the second impinger, 0.025.

B_{ws} = Water vapor in the gas stream, proportion by volume.

M_w = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole)

P_m = Absolute pressure (for this method, same as barometric pressure) at the dry gas meter.

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

R = Ideal gas constant, 0.06236 (mm Hg) (m^3)/(g-mole) (°K) for metric units and 21.85 (in. Hg) (ft^3)/lb-mole) (°R) for English units.

T_m = Absolute temperature at meter, °K (°R)

T_{std} = Standard absolute temperature, 293° K (528° R)

V_f = Final volume of impinger contents, ml.

V_i = Initial volume of impinger contents, ml.

V_m = Dry gas volume measured by dry gas meter, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by dry gas meter, corrected to standard conditions, dscm (dscf).

$V_{wc(std)}$ = Volume of water vapor condensed, corrected to standard conditions, scm (scf).

ρ_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).

3.3.2 Volume of water vapor collected.

$$V_{wc} = \frac{(V_f - V_i)\rho_w R T_{std}}{P_{std} M_w} = K_1 (V_f - V_i)$$

Equation 4-5

where:

K_1 = 0.001333 m^3/ml for metric units

= 0.04707 ft^3/ml for English units.

3.3.3 Gas volume.

$$V_{m(std)} = V_m \left(\frac{P_m}{P_{std}}\right)\left(\frac{T_{std}}{T_m}\right) = K_3 \frac{V_m P_m}{T_m}$$

Equation 4-6

where:

K_3 = 0.3858 °K/mm Hg for metric units

= 17.64 °R/in. Hg for English units

3.3.4 Approximate moisture content.

$$B_{ws} = \frac{V_{wc}}{V_{wc} + V_{m(std)}} + B_{wm} = \frac{V_{wc}}{V_{wc} + V_{m(std)}} + (0.025)$$

Equation 4-7

4. *Calibration*

4.1 For the reference method, calibrate equipment as specified in the following sections of Method 5: Section 5.3 (metering system); Section 5.5 (temperature gauges); and Section 5.7 (barometer). The recommended leak check of the metering system (Section 5.6 of Method 5) also applies to the reference method. For the approximation method, use the procedures outlined in Section 5.1.1 of Method 6 to calibrate the metering system, and the procedure of Method 5, Section 5.7 to calibrate the barometer.

5. *Bibliography*

1. Air Pollution Engineering Manual (Second Edition). Danielson, J. A. (ed.). U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, N.C. Publication No. AP-40. 1973.

2. Devorkin, Howard, et al. Air Pollution Source Testing Manual. Air Pollution Control District, Los Angeles, Calif. November, 1963.

3. Methods for Determination of Velocity, Volume, Dust and Mist Content of Gases. Western Precipitation Division of Joy Manufacturing Co., Los Angeles, Calif. Bulletin WP-50. 1968.

METHOD 6—DETERMINATION OF SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and Applicability*

1.1 Principle. A gas sample is extracted from the sampling point in the stack. The sulfuric acid mist (including sulfur trioxide) and the sulfur dioxide are separated. The sulfur dioxide fraction is measured by the barium-thorin titration method.

1.2 Applicability. This method is applicable for the determination of sulfur dioxide emissions from stationary sources. The minimum detectable limit of the method has been determined to be 3.4 milligrams (mg) of SO_2/m^3 (2.12×10^{-7} lb/ft³). Although no upper limit has been established, tests have shown that concentrations as high as 80,000 mg/m³ of SO_2 can be collected efficiently in two midget impingers, each containing 15 milliliters of 3 percent hydrogen peroxide, at a rate of 1.0 lpm for 20 minutes. Based on theoretical calculations, the upper concentration limit in a 20-liter sample is about 93,300 mg/m³.

Possible interferents are free ammonia, water-soluble cations, and fluorides. The cations and fluorides are removed by glass wool filters and an isopropanol bubbler, and hence do not affect the SO_2 analysis. When samples are being taken from a gas stream with high concentrations of very fine metallic fumes (such as in inlets to control devices), a high-efficiency glass fiber filter must be used in place of the glass wool plug (i.e., the one in the probe) to remove the cation interferents.

Free ammonia interferes by reacting with SO_2 to form particulate sulfite and by reacting with the indicator. If free ammonia is present (this can be determined by knowledge of the process and noticing white particulate matter in the probe and isopropanol bubbler), alternative methods, subject to the approval of the Administrator, U.S. Environmental Protection Agency, are required.

2. *Apparatus*

2.1 Sampling. The sampling train is shown in Figure 6-1, and component parts are discussed below. The tester has the option of substituting sampling equipment described in Method 8 in place of the midget impinger equipment of Method 6. However, the Method 8 train must be modified to include a heated filter between the probe and isopropanol impinger, and the operation of the sampling train and sample analysis must be at the flow rates and solution volumes defined in Method 8.

The tester also has the option of determining SO_2 simultaneously with particulate matter and moisture determinations by (1) replacing the water in a Method 5 impinger system with 3 percent perioxide solution, or (2) by replacing the Method 5 water impinger system with a Method 8 isopropanol-filter-peroxide system. The analysis for SO_2 must be consistent with the procedure in Method 8.

2.1.1 Probe. Borosilicate glass, or stainless steel (other materials of construction may be used, subject to the approval of the Administrator), approximately 6-mm inside diameter, with a heating system to prevent water condensation and a filter (either in-stack or heated out-stack) to remove particulate matter, including sulfuric acid mist. A plug of glass wool is a satisfactory filter.

2.1.2 Bubbler and Impingers. One midget bubbler, with medium-coarse glass frit and borosilicate or quartz glass wool packed in top (see Figure 6-1) to prevent sulfuric acid mist carryover, and three 30-ml midget impingers. The bubbler and midget impingers must be connected in series with leak-free glass connectors. Silicone grease may be used, if necessary, to prevent leakage.

At the option of the tester, a midget impinger may be used in place of the midget bubbler.

Other collection absorbers and flow rates may be used, but are subject to the approval of the Administrator. Also, collection efficiency must be shown to be at least 99 percent for each test run and must be documented in the report. If the efficiency is found to be acceptable after a series of three tests, further documentation is not required. To conduct the efficiency test, an extra absorber must be added and analyzed separately. This extra absorber must not contain more than 1 percent of the total SO_2.

2.1.3 Glass Wool. Borosilicate or quartz.

2.1.4 Stopcock Grease. Acetone-insoluble, heat-stable silicone grease may be used, if necessary.

2.1.5 Temperature Gauge. Dial thermometer, or equivalent, to measure temperature of gas leaving impinger train to within 1° C (2° F.)

2.1.6 Drying Tube. Tube packed with 6- to 16-mesh indicating type silica gel, or equivalent, to dry the gas sample and to protect the meter and pump. If the siliac gel has been used previously, dry at 175° C (350° F) for 2 hours. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used, subject to approval of the Administrator.

2.1.7 Value. Needle value, to regulate sample gas flow rate.

2.1.8 Pump. Leak-free diaphragm pump, or equivalent, to pull gas through the train. Install a small tank between the pump and rate meter to eliminate the pulsation effect of the diaphragm pump on the rotameter.

2.1.9 Rate Meter. Rotameter, or equivalent, capable of measuring flow rate to within 2 percent of the selected flow rate of about 1000 cc/min.

2.1.10 Volume Meter. Dry gas meter, sufficiently accurate to measure the sample volume within 2 percent, calibrated at the selected flow rate and conditions actually encountered during sampling, and equipped with a temperature gauge (dial thermometer, or equivalent) capable of measuring temperature to within 3°C (5.4°F).

2.1.11 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases, the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase or vice versa for elevation decrease.

2.1.12 Vacuum Gauge. At least 760 mm Hg (30 in. Hg) gauge, to be used for leak check of the sampling train.

2.2 Sample Recovery.

2.2.1 Wash bottles. Polyethylene or glass, 500 ml, two.

2.2.2 Storage Bottles. Polyethylene, 100 ml, to store impinger samples (one per sample).

2.3 Analysis.

2.3.1 Pipettes. Volumetric type, 5-ml, 20-ml (one per sample), and 25-ml sizes.

2.3.2 Volumetric Flasks. 100-ml size (one per sample) and 100-ml size.

2.3.3 Burettes. 5- and 50-ml sizes.

2.3.4 Erlenmeyer Flasks. 250 ml-size (one for each sample, blank, and standard).

2.3.5 Dropping Bottle. 125-ml size, to add indicator.

2.3.6 Graduated Cylinder. 100-ml size.

2.3.7 Spectrophotometer. To measure absorbance a 352 nanometers.

3. *Reagents*

Unless otherwise indicated, all reagents must conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society. Where such specifications are not available, use the best available grade.

3.1 Sampling.

3.1.1 Water. Deionized, distilled to conform to ASTM specification D1193-74, Type 3. At the option of the analyst, the $KMnO_4$ test for oxidizable organic matter may be omitted when high concentrations of organic matter are not expected to be present.

3.1.2 Isopropanol, 80 percent. Mix 80 ml of isopropanol with 20 ml of deionized, distilled water. Check each lot of isopropanol for peroxide impurities as follows: shake 10 ml of isopropanol with 10 ml of freshly prepared 10 percent potassium iodide solution. Prepare a blank by similarly treating 10 ml of distilled water. After 1 minute, read the absorbance at 352 nanometers on a spectrophotometer. If absorbance exceeds 0.1, reject alcohol for use.

Peroxides may be removed from isopropanol by redistilling or by passage through a column of activated alumina; however, reagent grade isopropanol with suitably low peroxide levels may be obtained from commercial sources. Rejection of contaminated lots may, therefore, be a more efficient procedure.

3.1.3 Hydrogen Peroxide, 3 Percent. Dilute 30 percent hydrogen peroxide 1:9 (v/v) with deionized, distilled water (30 ml is needed per sample). Prepare fresh daily.

3.1.4 Potassium Iodide Solution, 10 Percent. Dissolve 10.0 grams KI in deionized, distilled water and dilute to 100 ml. Prepare when needed.

3.2 Sample Recovery.

3.2.1 Water. Deionized, distilled, as in 3.1.1.

3.2.2 Isopropanol, 80 Percent. Mix 80 ml of isopropanol with 20 ml of deionized, distilled water.

3.3 Analysis.

3.3.1 Water. Deionized, distilled, as in 3.1.1.

3.3.2 Isopropanol, 100 percent.

3.3.3 Thorin Indicator. 1-(o-arsonophenylazo)-2-naphthol-3,6-disulfonic acid, disodium salt, or equivalent. Dissolve 0.20 g in 100 ml of deionized, distilled water.

3.3.4 Barium Perchlorate Solution, 0.0100 N. Dissolve 1.95 g of barium perchlorate trihydrate [$Ba(ClO_4)_2\cdot3H_2O$] in 200 ml distilled water and dilute to 1 liter with isopropanol. Alternatively, 1.22 g of [$BaCl_2\cdot2H_2O$] may be used instead of the perchlorate. Standardize as in Section 5.5.

3.3.5 Sulfuric Acid Standard, 0.0100 N. Purchase or standardize to ±0.0002 N against 0.0100 N NaOH which has previously been standardized against potassium acid phthalate (primary standard grade).

4. *Procedure*.

4.1 Sampling.

4.1.1 Preparation of collection train. Measure 15 ml of 80 percent isopropanol into the midget bubbler and 15 ml of 3 percent hydrogen peroxide into each of the first two midget impingers. Leave the final midget impinger dry. Assemble the train as shown in Figure 6-1. Adjust probe heater to a temperature sufficient to prevent water condensation. Place crushed ice and water around the impingers.

4.1.2 Leak-check procedure. A leak check prior to the sampling run is optional; however, a leak check after the sampling run is mandatory. The leak-check procedure is as follows:

With the probe disconnected, place a vacuum gauge at the inlet to the bubbler and pull a vacuum of 250 mm (10 in.) Hg; plug or pinch off the outlet of the flow meter, and then turn off the pump. The vacuum shall remain stable for at least 30 seconds. Carefully release the vacuum gauge before releasing the flow meter end to prevent back flow of the impinger fluid.

Other leak check procedures may be used, subject to the approval of the Administrator, U.S. Environmental Protection Agency. The procedure used in Method 5 is not suitable for diaphragm pumps.

4.1.3 Sample collection. Record the initial dry gas meter reading and barometric pressure. To begin sampling, position the tip of the probe at the sampling point, connect the probe to the bubbler, and start the pump. Adjust the sample flow to a constant rate of approximately 1.0 liter/min as indicated by the rotameter. Maintain this constant rate (±10 percent) during the entire sampling run. Take readings (dry gas meter, temperatures at dry gas meter and at impinger outlet and rate meter) at least every 5 minutes. Add more ice during the run to keep the temperature of the gases leaving the last impinger at 20° C (68° F) or less. At the conclusion of each run, turn off the pump, remove probe from the stack, and record the final readings. Conduct a leak check as in Section 4.1.2. (This leak check is mandatory.) If a leak is found, void the test run. Drain the ice bath, and purge the remaining part of the train by drawing clean ambient air through the system for 15 minutes at the sampling rate.

Clean ambient air can be provided by passing air through a charcoal filter or through an extra midget impinger with 15 ml of 3 percent H_2O_2. The tester may opt to simply use ambient air, without purification.

4.2 Sample Recovery. Disconnect the impingers after purging. Discard the contents of the midget bubbler. Pour the contents of the midget impingers into a leak-free polyethylene bottle for shipment. Rinse the three midget impingers and the connecting tubes with deionized distilled water, and add the washings to the same storage container. Mark the fluid level. Seal and identify the sample container.

4.3 Sample Analysis. Note level of liquid in container, and confirm whether any sample was lost during shipment; note this on analytical data sheet. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results.

Transfer the contents of the storage container to a 100-ml volumetric flask and dilute to exactly 100 ml with deionized, distilled water. Pipette a 20-ml aliquot of this solution into a 250-ml Erlenmeyer flask, add 80 ml of 100 percent isopropanol and two to four drops of thorin indicator, and titrate to a pink endpoint using 0.0100 N barium perchlorate. Repeat and average the titration volumes. Run a blank with each series of samples. Replicate titrations must agree within 1 percent or 0.2 ml, whichever is larger.

(NOTE.—Protect the 0.0100 N barium perchlorate solution from evaporation at all times.)

5. *Calibration*

5.1 Metering System.

5.1.1 Initial Calibration. Before its initial use in the field, first leak check the metering system (drying tube, needle valve, pump, rotameter, and dry gas meter) as follows: place a vacuum gauge at the inlet to the drying tube and pull a vacuum of 250 mm (10 in.) Hg; plug or pinch off the outlet or the flow meter, and then turn off the pump. The vacuum shall remain stable for at least 30 seconds. Carefully release the vacuum gauge before releasing the flow meter end.

Next, calibrate the metering system (at the sampling flow rate specified by the method) as follows: connect an appropriately sized wet test meter (e.g., 1 liter per revolution) to the inlet of the drying tube. Make three independent calibration runs, using at least five revolutions of the dry gas meter per run. Calculate the calibration factor, Y (wet test meter calibration volume divided by the dry gas meter volume, both volumes adjusted to the same reference temperature and pressure), for each run, and average the results. If any Y value deviates by more than 2 percent from the average, the metering system is unacceptable for use. Otherwise, use the average as the calibration factor for subsequent test runs.

5.1.2 Post-Test Calibration Check. After each field test series, conduct a calibration check as in Section 5.1.1 above, except for the following variations: (a) the leak check is not to be conducted, (b) three, or more revolutions of the dry gas meter may be used, and (c) only two independent runs need be made. If the calibration factor does not deviate by more than 5 percent from the initial calibration factor (determined in Section 5.1.1), then the dry gas meter volumes obtained during the test series are acceptable. If the calibration factor deviates by more than 5 percent, recalibrate the metering system as in Section 5.1.1, and for the calculations, use the calibration factor (initial or recalibration) that yields the lower gas volume for each test run.

Reproduced from
best available copy.

5.2 Thermometers. Calibrate against mercury-in-glass thermometers.

5.3 Rotameter. The rotameter need not be calibrated but should be cleaned and maintained according to the manufacturer's instruction.

5.4 Barometer. Calibrate against a mercury barometer.

5.5 Barium Perchlorate Solution. Standardize the barium perchlorate solution against 25 ml of standard sulfuric acid to which 100 ml of 100 percent isopropanol has been added.

6. *Calculations*

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

6.1 Nomenclature.

C_{SO_2} = Concentration of sulfur dioxide, dry basis corrected to standard conditions, mg/dscm (lb/dscf).

N = Normality of barium perchlorate titrant, milliequivalents/ml.

P_{bar} = Barometric pressure at the exit orifice of the dry gas meter, mm Hg (in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

T_m = Average dry gas meter absolute temperature, °K (°R).

T_{std} = Standard absolute temperature, 293° K (528° R).

V_a = Volume of sample aliquot titrated, ml.

V_m = Dry gas volume as measured by the dry gas meter, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

V_{soln} = Total volume of solution in which the sulfur dioxide sample is contained, 100 ml.

V_t = Volume of barium perchlorate titrant used for the sample, ml (average of replicate titrations).

V_{tb} = Volume of barium perchlorate titrant used for the blank, ml.

Y = Dry gas meter calibration factor.

32.03 = Equivalent weight of sulfur dioxide.

6.2 Dry sample gas volume, corrected to standard conditions.

$$V_{m(std)} = V_m Y \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar}}{P_{std}}\right) = K_1 Y \frac{V_m P_{bar}}{T_m}$$

Equation 6-1

where:

K_1 = 0.3858 °K/mm Hg for metric units.
= 17.64 °R/in. Hg for English units.

6.3 Sulfur dioxide concentration.

$$C_{SO_2} = K_2 \frac{(V_t - V_{tb})\, N \left(\frac{V_{soln}}{V_a}\right)}{V_{m(std)}}$$

Equation 6-2

where:

K_2 = 32.03 mg/meq. for metric units.
= 7.061×10⁻⁵ lb/meq. for English units.

7. *Bibliography*

1. Atmospheric Emissions from Sulfuric Acid Manufacturing Processes. U.S. DHEW, PHS, Division of Air Pollution. Public Health Service Publication No. 999-AP-13. Cincinnati, Ohio. 1965.

2. Corbett, P. F. The Determination of SO_2 and SO_3 in Flue Gases. Journal of the Institute of Fuel. 24: 237-242. 1961.

3. Matty, R. E. and E. K. Diehl. Measuring Flue-Gas SO_2 and SO_3. Power. 101: 94-97. November 1957.

4. Patton, W. F. and J. A. Brink, Jr. New Equipment and Techniques for Sampling Chemical Process Gases. J. Air Pollution Control Association. 13: 162. 1963.

5. Rom, J. J. Maintenance, Calibration, and Operation of Isokinetic Source-Sampling Equipment. Office of Air Programs, Environmental Protection Agency. Research Triangle Park, N.C. APTD-0576. March 1972.

6. Hamil, H. F. and D. E. Camann. Collaborative Study of Method for the Determination of Sulfur Dioxide Emissions from Stationary Sources (Fossil Fuel Fired Steam Generators). Environmental Protection Agency, Research Triangle Park, N.C. EPA-650/4-74-024. December 1973.

7. Annual Book of ASTM Standards. Part 31; Water, Atmospheric Analysis. American Society for Testing and Materials. Philadelphia, Pa. 1974. pp. 40-42.

8. Knoll, J. E. and M. R. Midgett. The Application of EPA Method 6 to High Sulfur Dioxide Concentrations. Environmental Protection Agency. Research Triangle Park, N.C. EPA-600/4-76-038. July 1976.

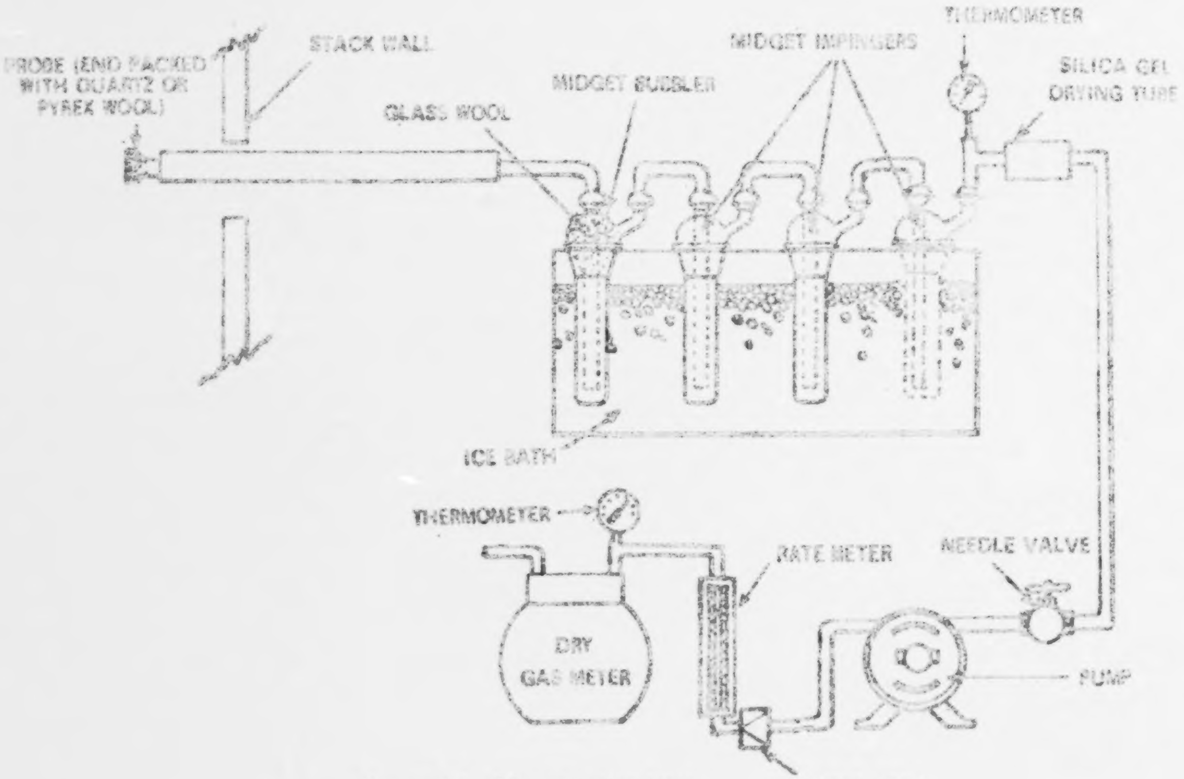


Figure 6-1. SO_2 sampling train.

METHOD 7—DETERMINATION OF NITROGEN OXIDE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and Applicability*

1.1 Principle. A grab sample is collected in an evacuated flask containing a dilute sulfuric acid-hydrogen peroxide absorbing solution, and the nitrogen oxides, except nitrous oxide, are measured colorimeterically using the phenoldisulfonic acid (PDS) procedure.

1.2 Applicability. This method is applicable to the measurement of nitrogen oxides emitted from stationary sources. The range of the method has been determined to be 2 to 400 milligrams NO_x (as NO_2) per dry standard cubic meter, without having to dilute the sample.

2. *Apparatus*

2.1 Sampling (see Figure 7-1). Other grab sampling systems or equipment, capable of measuring sample volume to within ±2.0 percent and collecting a sufficient sample volume to allow analytical reproducibility to within ±5 percent, will be considered acceptable alternatives, subject to approval of the Administrator, U.S. Environmental Protection Agency. The following equipment is used in sampling:

2.1.1 Probe. Borosilicate glass tubing, sufficiently heated to prevent water condensation and equipped with an in-stack or out-stack filter to remove particulate matter (a plug of glass wool is satisfactory for this purpose). Stainless steel or Teflon[1] tubing may also be used for the probe. Heating is not necessary if the probe remains dry during the purging period.

2.1.2 Collection Flask. Two-liter borosilicate, round bottom flask, with short neck and 24/40 standard taper opening, protected against implosion or breakage.

2.1.3 Flask Valve. T-bore stopcock connected to a 24/40 standard taper joint.

2.1.4 Temperature Gauge. Dial-type thermometer, or other temperature gauge, capable of measuring 1° C (2° F) intervals from −5 to 50° C (25 to 125° F).

2.1.5 Vacuum Line. Tubing capable of withstanding a vacuum of 75 mm Hg (3 in. Hg) absolute pressure, with "T" connection and T-bore stopcock.

2.1.6 Vacuum Gauge. U-tube manometer, 1 meter (36 in.), with 1-mm (0.1-in.) divisions, or other gauge capable of measuring pressure to within ±2.5 mm Hg (0.10 in. Hg).

2.1.7 Pump. Capable of evacuating the collection flask to a pressure equal to or less than 75 mm Hg (3 in. Hg) absolute.

2.1.8 Squeeze Bulb. One-way.

2.1.9 Volumetric Pipette. 25 ml.

2.1.10 Stopcock and Ground Joint Grease. A high-vacuum, high-temperature chlorofluorocarbon grease is required. Halocarbon 25-5S has been found to be effective.

2.1.11 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases, the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase, or vice versa for elevation decrease.

2.2 Sample Recovery. The following equipment is required for sample recovery:

2.2.1 Graduated Cylinder. 50 ml with 1-ml divisions.

2.2.2 Storage Containers. Leak-free polyethylene bottles.

2.2.3 Wash Bottle. Polyethylene or glass.

2.2.4 Glass Stirring Rod.

2.2.5 Test Paper for Indicating pH. To cover the pH range of 7 to 14.

2.3 Analysis. For the analysis, the following equipment is needed:

2.3.1 Volumetric Pipettes. Two 1 ml, two 2 ml, one 3 ml, one 4 ml, two 10 ml, and one 25 ml for each sample and standard.

2.3.2 Porcelain Evaporating Dishes. 175- to 250-ml capacity with lip for pouring, one for each sample and each standard. The Coors No. 45006 (shallow-form, 195 ml) has been found to be satisfactory. Alternatively, polymethyl pentene beakers (Nalge No. 1203, 150 ml), or glass beakers (150 ml) may be used. When glass beakers are used, etching of the beakers may cause solid matter to be present in the analytical step, the solids should be removed by filtration (see Section 4.3).

2.3.3 Steam Bath. Low-temperature ovens or thermostatically controlled hot plates kept below 70° C (160° F) are acceptable alternatives.

2.3.4 Dropping Pipette or Dropper. Three required.

2.3.5 Polyethylene Policeman. One for each sample and each standard.

2.3.6 Graduated Cylinder. 100 ml with 1-ml divisions.

2.3.7 Volumetric Flasks. 50 ml (one for each sample), 100 ml (one for each sample and each standard, and one for the working standard KNO_3 solution), and 1000 ml (one).

2.3.8 Spectrophotometer. To measure absorbance at 410 nm.

2.3.9 Graduated Pipette. 10 ml with 0.1-ml divisions.

2.3.10 Test Paper for Indicating pH. To cover the pH range of 7 to 14.

2.3.11 Analytical Balance. To measure to within 0.1 mg.

---

[1] Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

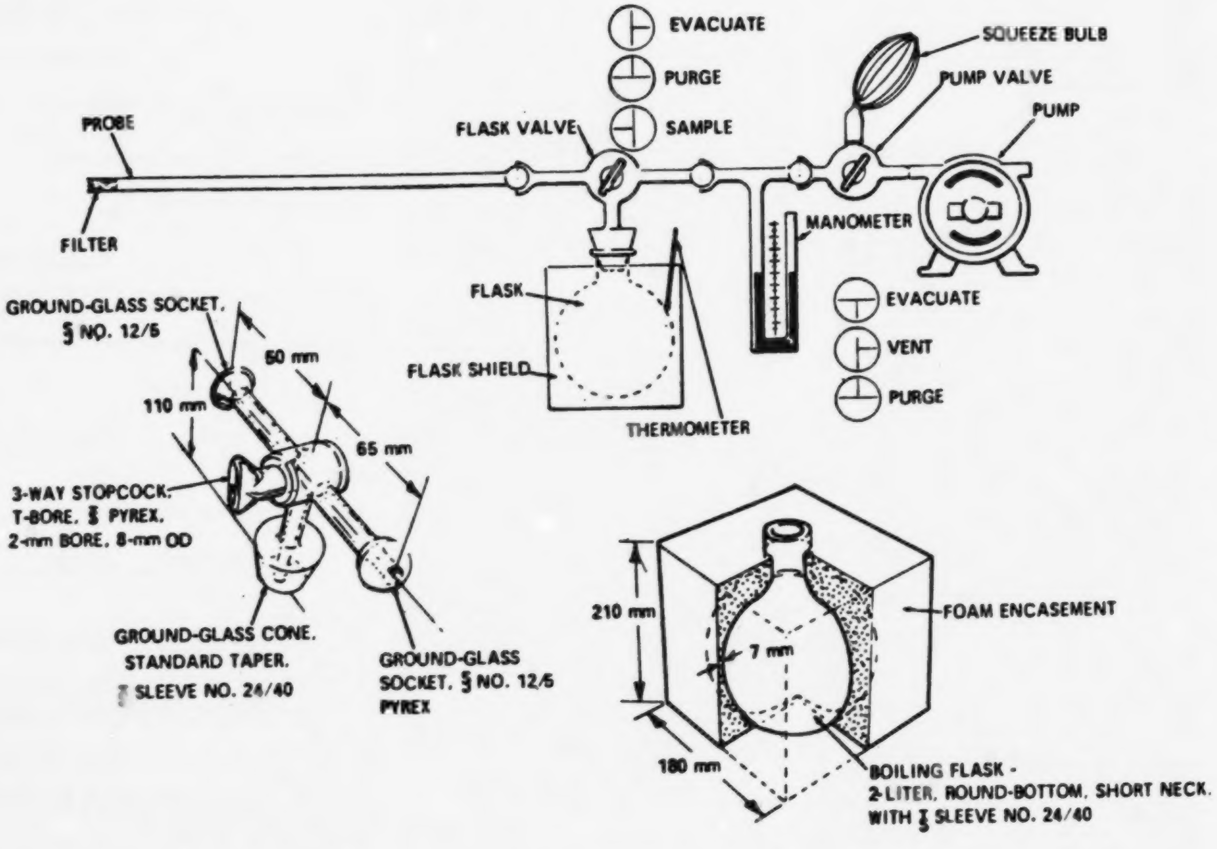

EVACUATE
PURGE
SAMPLE
SQUEEZE BULB
PUMP VALVE
PUMP
PROBE
FLASK VALVE
FILTER
MANOMETER
FLASK
EVACUATE
VENT
PURGE
FLASK SHIELD
THERMOMETER
GROUND-GLASS SOCKET, § NO. 12/5
50 mm
110 mm
65 mm
3-WAY STOPCOCK; T-BORE, § PYREX, 2-mm BORE, 8-mm OD
GROUND-GLASS CONE, STANDARD TAPER, § SLEEVE NO. 24/40
GROUND-GLASS SOCKET, § NO. 12/5 PYREX
210 mm
7 mm
FOAM ENCASEMENT
180 mm
BOILING FLASK - 2-LITER, ROUND-BOTTOM, SHORT NECK, WITH § SLEEVE NO. 24/40

Figure 7-1. Sampling train, flask valve, and flask.

3. Reagents

Unless otherwise indicated, it is intended that all reagents conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available; otherwise, use the best available grade.

3.1 Sampling. To prepare the absorbing solution, cautiously add 2.8 ml concentrated H_2SO_4 to 1 liter of deionized, distilled water. Mix well and add 6 ml of 3 percent hydrogen peroxide, freshly prepared from 30 percent hydrogen peroxide solution. The absorbing solution should be used within 1 week of its preparation. Do not expose to extreme heat or direct sunlight.

3.2 Sample Recovery. Two reagents are required for sample recovery:

3.2.1 Sodium Hydroxide (1N). Dissolve 40 g NaOH in deionized, distilled water and dilute to 1 liter.

3.2.2 Water. Deionized, distilled to conform to ASTM specification D1193-74, Type 3. At the option of the analyst, the $KMnO_4$ test for oxidizable organic matter may be omitted when high concentrations of organic matter are not expected to be present.

3.3 Analysis. For the analysis, the following reagents are required:

3.3.1 Fuming Sulfuric Acid. 15 to 18 percent by weight free sulfur trioxide. HANDLE WITH CAUTION.

3.3.2 Phenol. White solid.

3.3.3 Sulfuric Acid. Concentrated, 95 percent minimum assay. HANDLE WITH CAUTION.

3.3.4 Potassium Nitrate. Dried at 105 to 110° C (220 to 230° F) for a minimum of 2 hours just prior to preparation of standard solution.

3.3.5 Standard KNO_3 Solution. Dissolve exactly 2.198 g of dried potassium nitrate (KNO_3) in deionized, distilled water and dilute to 1 liter with deionized, distilled water in a 1,000-ml volumetric flask.

3.3.6 Working Standard KNO_3 Solution. Dilute 10 ml of the standard solution to 100 ml with deionized distilled water. One milliliter of the working standard solution is equivalent to 100 μg nitrogen dioxide (NO_2).

3.3.7 Water. Deionized, distilled as in Section 3.2.2.

3.3.8 Phenoldisulfonic Acid Solution. Dissolve 25 g of pure white phenol in 150 ml concentrated sulfuric acid on a steam bath. Cool, add 75 ml fuming sulfuric acid, and heat at 100° C (212° F) for 2 hours. Store in a dark, stoppered bottle.

4. Procedures

4.1 Sampling.

4.1.1 Pipette 25 ml of absorbing solution into a sample flask, retaining a sufficient quantity for use in preparing the calibration standards. Insert the flask valve stopper into the flask with the valve in the "purge" position. Assemble the sampling train as shown in Figure 7-1 and place the probe at the sampling point. Make sure that all fittings are tight and leak-free, and that all ground glass joints have been properly greased with a high-vacuum, high-temperature chlorofluorocarbon-based stopcock grease. Turn the flask valve and the pump valve to their "evacuate" positions. Evacuate the flask to 75 mm Hg (3 in. Hg) absolute pressure, or less. Evacuation to a pressure approaching the vapor pressure of water at the existing temperature is desirable. Turn the pump valve to its "vent" position and turn off the pump. Check for leakage by observing the manometer for any pressure fluctuation. (Any variation greater than 10 mm Hg (0.4 in. Hg) over a period of 1 minute is not acceptable, and the flask is not to be used until the leakage problem is corrected. Pressure in the flask is not to exceed 75 mm Hg (3 in. Hg) absolute at the time sampling is commenced.) Record the volume of the flask and valve (V_f), the flask temperature (T_i), and the barometric pressure. Turn the flask valve counterclockwise to its "purge" position and do the same with the pump valve. Purge the probe and the vacuum tube using the squeeze bulb. If condensation occurs in the probe and the flask valve area, heat the probe and purge until the condensation disappears. Next, turn the pump valve to its "vent" position. Turn the flask valve clockwise to its "evacuate" position and record the difference in the mercury levels in the manometer. The absolute internal pressure in the flask (P_i) is equal to the barometric pressure less the manometer reading. Immediately turn the flask valve to the "sample" position and permit the gas to enter the flask until pressures in the flask and sample line (i.e., duct, stack) are equal. This will usually require about 15 seconds; a longer period indicates a "plug" in the probe, which must be corrected before sampling is continued. After collecting the sample, turn the flask valve to its "purge" position and disconnect the flask from the sampling train. Shake the flask for at least 5 minutes.

4.1.2 If the gas being sampled contains insufficient oxygen for the conversion of NO to NO_2 (e.g., an applicable subpart of the standard may require taking a sample of a calibration gas mixture of NO in N_2), then oxygen shall be introduced into the flask to permit this conversion. Oxygen may be introduced into the flask by one of three methods; (1) Before evacuating the sampling flask, flush with pure cylinder oxygen, then evacuate flask to 75 mm Hg (3 in. Hg) absolute pressure or less; or (2) inject oxygen into the flask after sampling; or (3) terminate sampling with a minimum of 50 mm Hg (2 in. Hg) vacuum remaining in the flask, record this final pressure, and then vent the flask to the atmosphere until the flask pressure is almost equal to atmospheric pressure.

4.2 Sample Recovery. Let the flask set for a minimum of 16 hours and then shake the contents for 2 minutes. Connect the flask to a mercury filled U-tube manometer. Open the valve from the flask to the manometer and record the flask temperature (T_f), the barometric pressure, and the difference between the mercury levels in the manometer. The absolute internal pressure in the flask (P_f) is the barometric pressure less the manometer reading. Transfer the contents of the flask to a leak-free polyethylene bottle. Rinse the flask twice with 5-ml portions of deionized, distilled water and add the rinse water to the bottle. Adjust the pH to between 9 and 12 by adding sodium hydroxide (1 N), dropwise (about 25 to 35 drops). Check the pH by dipping a stirring rod into the solution and then touching the rod to the pH test paper. Remove as little material as possible during this step. Mark the height of the liquid level so that the container can be checked for leakage after transport. Label the container to clearly identify its contents. Seal the container for shipping.

4.3 Analysis. Note the level of the liquid in container and confirm whether or not any sample was lost during shipment; note this on the analytical data sheet. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results. Immediately prior to analysis, transfer the contents of the shipping container to a 50-ml volumetric flask, and rinse the container twice with 5-ml portions of deionized, distilled water. Add the rinse water to the flask and dilute to the mark with deionized, distilled water; mix thoroughly. Pipette a 25-ml aliquot into the procelain evaporating dish. Return any unused portion of the sample to the polyethylene storage bottle. Evaporate the 25-ml aliquot to dryness on a steam bath and allow to cool. Add 2 ml phenoldisulfonic acid solution to the dried residue and triturate thoroughly with a polyethylene policeman. Make sure the solution contacts all the residue. Add 1 ml deionized, distilled water and four drops of concentrated sulfuric acid. Heat the solution on a steam bath for 3 minutes with occasional stirring. Allow the solution to cool, add 20 ml deionized, distilled water, mix well by stirring, and add concentrated ammonium hydroxide, dropwise, with constant stirring, until the pH is 10 (as determined by pH paper). If the sample contains solids, these must be removed by filtration (centrifugation is an acceptable alternative, subject to the approval of the Administrator), as follows: filter through Whatman No. 41 filter paper into a 100-ml volumetric flask; rinse the evaporating dish with three 5-ml portions of deionized, distilled water; filter these three rinses. Wash the filter with at least three 15-ml portions of deionized, distilled water. Add the filter washings to the contents of the volumetric flask and dilute to the mark with deionized, distilled water. If solids are absent, the solution can be transferred directly to the 100-ml volumetric flask and diluted to the mark with deionized, distilled water. Mix the contents of the flask thoroughly, and measure the absorbance at the optimum wavelength used for the standards (Section 5.2.1), using the blank solution as a zero reference. Dilute the sample and the blank with equal volumes of deionized, distilled water if the absorbance exceeds A_4, the absorbance of the 400 μg NO_2 standard (see Section 5.2.2).

5. Calibration

5.1 Flask Volume. The volume of the collection flask-flask valve combination must be known prior to sampling. Assemble the flask and flask valve and fill with water, to the stopcock. Measure the volume of water to ±10 ml. Record this volume on the flask.

5.2 Spectrophotometer Calibration.

5.2.1 Optimum Wavelength Determination. For both fixed and variable wavelength spectrophotometers, calibrate against standard certified wavelength of 410 nm, every 6 months. Alternatively, for variable wave length spectrophotometers, scan the spectrum between 400 and 415 nm using a 200 μg NO_2 standard solution (see Section 5.2.2). If a peak does not occur, the spectrophotometer is probably malfunctioning, and should be repaired. When a peak is obtained within the 400 to 415 nm range, the wavelength at which this peak occurs shall be the optimum wavelength for the measurement of absorbance for both the standards and samples.

5.2.2 Determination of Spectrophotometer Calibration Factor K_c. Add 0.0, 1.0, 2.0, 3.0, and 4.0 ml of the KNO_3 working standard solution (1 ml = 100 μg NO_2) to a series of five porcelain evaporating dishes. To each, add 25 ml of absorbing solution, 10 ml deionized, distilled water, and sodium hydroxide (1N), dropwise, until the pH is between 9 and 12 (about 25 to 35 drops each). Beginning with the evaporation step, follow the analysis procedure of Section 4.3, until the solution has been transferred to the 100 ml volumetric flask and diluted to the mark. Measure the absorbance of each solution, at the optimum wavelength, as determined in Section 5.2.1. This calibration procedure must be repeated on each day that samples are analyzed. Calculate the spectrophotometer calibration factor as follows:

$$K_c = 100\,\frac{A_1 + 2A_2 + 3A_3 + 4A_4}{A_1^2 + A_2^2 + A_3^2 + A_4^2}$$

Equation 7-1

where:

K_c = Calibration factor

A_1 = Absorbance of the 100-μg NO_2 standard

A_2 = Absorbance of the 200-μg NO_2 standard

A_3 = Absorbance of the 300-μg NO_2 standard

A_4 = Absorbance of the 400-μg NO_2 standard

5.3 Barometer. Calibrate against a mercury barometer.

5.4 Temperature Gauge. Calibrate dial thermometers against mercury-in-glass thermometers.

5.5 Vacuum Gauge. Calibrate mechanical gauges, if used, against a mercury manometer such as that specified in 2.1.6.

5.6 Analytical Balance. Calibrate against standard weights.

6. Calculations

Carry out the calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculations.

6.1 Nomenclature.

A = Absorbance of sample.

C = Concentration of NO_x as NO_2, dry basis, corrected to standard conditions, mg/dscm (lb/dscf).

F = Dilution factor (i.e., 25/5, 25/10, etc., required only if sample dilution was needed to reduce the absorbance into the range of calibration).

K_c = Spectrophotometer calibration factor.

m = Mass of NO_x as NO_2 in gas sample, μg.

P_f = Final absolute pressure of flask, mm Hg (in. Hg).

P_i = Initial absolute pressure of flask, mm Hg (in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

T_f = Final absolute temperature of flask, °K (°R).

T_i = Initial absolute temperature of flask, °K (°R).

T_{std} = Standard absolute temperature, 293° K (528° R).

V_{sc} = Sample volume at standard conditions (dry basis), ml.

V_f = Volume of flask and valve, ml.

V_a = Volume of absorbing solution, 25 ml.

2 = 50/25, the aliquot factor. (If other than a 25-ml aliquot was used for analysis, the corresponding factor must be substituted).

6.2 Sample volume, dry basis, corrected to standard conditions.

$$V_{sc} = \frac{T_{std}}{P_{std}}\,(V_f - V_a)\left[\frac{P_f}{T_f} - \frac{P_i}{T_i}\right]$$

$$= K_1\,(V_f - 25\ \text{ml})\left[\frac{P_f}{T_f} - \frac{P_i}{T_i}\right]$$

Equation 7-2

where

$$K_1 = 0.3858\ \frac{°\text{K}}{\text{mm Hg}}\ \text{for metric units}$$

$$= 17.64\ \frac{°\text{R}}{\text{in. Hg}}\ \text{for English units}$$

6.3 Total μg NO_2 per sample.

$$m = 2\,K_c\,AF$$

Equation 7-3

NOTE.—If other than a 25-ml aliquot is used for analysis, the factor 2 must be replaced by a corresponding factor.

6.4 Sample concentration, dry basis, corrected to standard conditions.

$$C = K_2\,\frac{m}{V_{sc}}$$

Equation 7-4

where:

$$K_2 = 10^3\ \frac{\text{mg/m}^3}{\mu\text{g/ml}}\ \text{for metric units}$$

$$= 6.243 \times 10^{-5}\ \frac{\text{lb/scf}}{\mu\text{g/ml}}\ \text{for English units}$$

7. Bibliography

1. Standard Methods of Chemical Analysis. 6th ed. New York, D. Van Nostrand Co., Inc. 1962. Vol. 1, p. 329-330.

2. Standard Method of Test for Oxides of Nitrogen in Gaseous Combustion Products (Phenoldisulfonic Acid Procedure). In: 1968 Book of ASTM Standards, Part 26. Philadelphia, Pa. 1968. ASTM Designation D-1608-60, p. 725-729.

3. Jacob, M. B. The Chemical Analysis of Air Pollutants. New York. Interscience Publishers, Inc. 1960. Vol. 10, p. 351-356.

4. Beatty, R. L., L. B. Berger, and H. H. Schrenk. Determination of Oxides of Nitrogen by the Phenoldisulfonic Acid Method. Bureau of Mines, U.S. Dept. of Interior. R. I. 3687. February 1943.

5. Hamil, H. F. and D. E. Camann. Collaborative Study of Method for the Determination of Nitrogen Oxide Emissions from Stationary Sources (Fossil Fuel-Fired Steam Generators). Southwest Research Institute report for Environmental Protection Agency. Research Triangle Park, N.C. October 5, 1973.

6. Hamil, H. F. and R. E. Thomas. Collaborative Study of Method for the Determination of Nitrogen Oxide Emissions from Stationary Sources (Nitric Acid Plants). Southwest Research Institute report for Environmental Protection Agency. Research Triangle Park, N.C. May 8, 1974.

METHOD 8—DETERMINATION OF SULFURIC ACID MIST AND SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and Applicability*

1.1 Principle. A gas sample is extracted isokinetically from the stack. The sulfuric acid mist (including sulfur trioxide) and the sulfur dioxide are separated, and both fractions are measured separately by the barium-thorin titration method.

1.2 Applicability. This method is applicable for the determination of sulfuric acid mist (including sulfur trioxide, and in the absence of other particulate matter) and sulfur dioxide emissions from stationary sources. Collaborative tests have shown that the minimum detectable limits of the method are 0.05 milligrams/cubic meter (0.03×10^{-7} pounds/cubic foot) for sulfur trioxide and 1.2 mg/m^3 (0.74×10^{-7} lb/ft^3) for sulfur dioxide. No upper limits have been established. Based on theoretical calculations for 200 milliliters of 3 percent hydrogen peroxide solution, the upper concentration limit for sulfur dioxide in a 1.0 m^3 (35.3 ft^3) gas sample is about 12,500 mg/m^3 (7.7×10^{-4} lb/ft^3). The upper limit can be extended by increasing the quantity of peroxide solution in the impingers.

Possible interfering agents of this method are fluorides, free ammonia, and dimethyl aniline. If any of these interfering agents are present (this can be determined by knowledge of the process), alternative methods, subject to the approval of the Administrator, are required.

Filterable particulate matter may be determined along with SO$_3$ and SO$_2$ (subject to the approval of the Administrator); however, the procedure used for particulate matter must be consistent with the specifications and procedures given in Method 5.

2. *Apparatus*

2.1 Sampling. A schematic of the sampling train used in this method is shown in Figure 8-1; it is similar to the Method 5 train except that the filter position is different and the filter holder does not have to be heated. Commercial models of this train are available. For those who desire to build their own, however, complete construction details are described in APTD-0581. Changes from the APTD-0581 document and allowable modifications to Figure 8-1 are discussed in the following subsections.

The operating and maintenance procedures for the sampling train are described in APTD-0576. Since correct usage is important in obtaining valid results, all users should read the APTD-0576 document and adopt the operating and maintenance procedures outlined in it, unless otherwise specified herein. Further details and guidelines on operation and maintenance are given in Method 5 and should be read and followed whenever they are applicable.

2.1.1 Probe Nozzle. Same as Method 5, Section 2.1.1.

2.1.2 Probe Liner. Borosilicate or quartz glass, with a heating system to prevent visible condensation during sampling. Do not use metal probe liners.

2.1.3 Pitot Tube. Same as Method 5, Section 2.1.3.

2.1.4 Differential Pressure Gauge. Same as Method 5, Section 2.1.4.

2.1.5 Filter Holder. Borosilicate glass, with a glass frit filter support and a silicone rubber gasket. Other gasket materials, e.g., Teflon or Viton, may be used subject to the approval of the Administrator. The holder design shall provide a positive seal against leakage from the outside or around the filter. The filter holder shall be placed between the first and second impingers. Note: Do not heat the filter holder.

2.1.6 Impingers—Four, as shown in Figure 8-1. The first and third shall be of the Greenburg-Smith design with standard tips. The second and fourth shall be of the Greenburg-Smith design, modified by replacing the insert with an approximately 13 millimeter (0.5 in.) ID glass tube, having an unconstricted tip located 13 mm (0.5 in.) from the bottom of the flask. Similar collection systems, which have been approved by the Administrator, may be used.

2.1.7 Metering System. Same as Method 5, Section 2.1.8.

2.1.8 Barometer. Same as Method 5, Section 2.1.9.

2.1.9 Gas Density Determination Equipment. Same as Method 5, Section 2.1.10.

2.1.10 Temperature Gauge. Thermometer, or equivalent, to measure the temperature of the gas leaving the impinger train to within 1° C (2° F).

2.2 Sample Recovery.

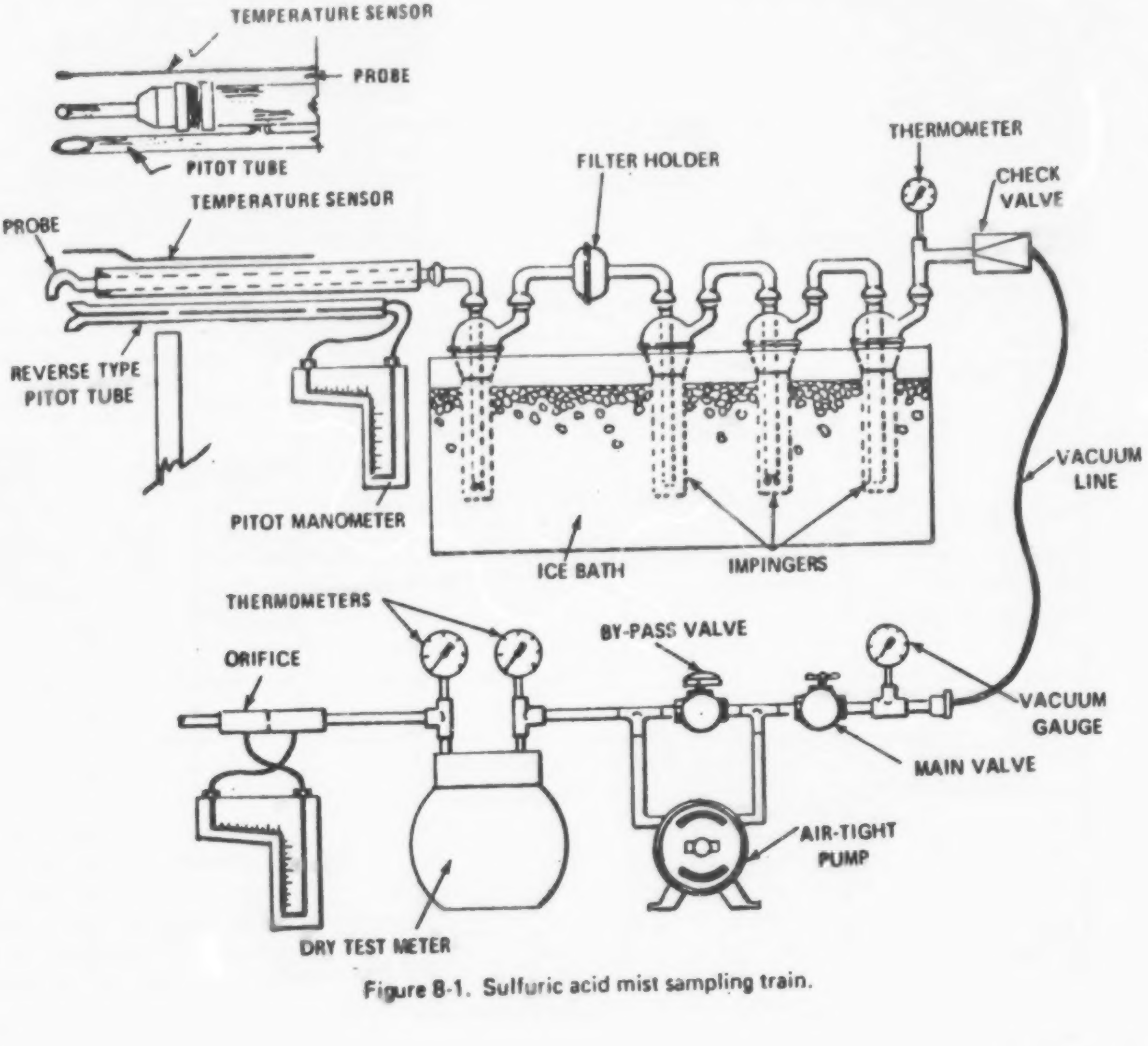


Figure 8-1. Sulfuric acid mist sampling train.

2.2.1 Wash Bottles. Polyethylene or glass, 500 ml. (two).

2.2.2 Graduated Cylinders. 250 ml, 1 liter. (Volumetric flasks may also be used.)

2.2.3 Storage Bottles. Leak-free polyethylene bottles, 1000 ml size (two for each sampling run).

2.2.4 Trip Balance. 500-gram capacity, to measure to ±0.5 g (necessary only if a moisture content analysis is to be done).

2.3 Analysis.

2.3.1 Pipettes. Volumetric 25 ml, 100 ml.

2.3.2 Burrette. 50 ml.

2.3.3 Erlenmeyer Flask. 250 ml. (one for each sample blank and standard).

2.3.4 Graduated Cylinder. 100 ml.

2.3.5 Trip Balance. 500 g capacity, to measure to ±0.5 g.

2.3.6 Dropping Bottle. To add indicator solution, 125-ml size.

3. *Reagents*

Unless otherwise indicated, all reagents are to conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Otherwise, use the best available grade.

3.1 Sampling.

3.1.1 Filters. Same as Method 5, Section 3.1.1.

3.1.2 Silica Gel. Same as Method 5, Section 3.1.2.

3.1.3 Water. Deionized, distilled to conform to ASTM specification D1193-74, Type 3. At the option of the analyst, the $KMnO_4$ test for oxidizable organic matter may be omitted when high concentrations of organic matter are not expected to be present.

3.1.4 Isopropanol, 80 Percent. Mix 800 ml of isopropanol with 200 ml of deionized, distilled water.

NOTE.—Experience has shown that only A.C.S. grade isopropanol is satisfactory. Tests have shown that isopropanol obtained from commercial sources occasionally has peroxide impurities that will cause erroneously high sulfuric acid mist measurement. Use the following test for detecting peroxides in each lot of isopropanol: Shake 10 ml of the isopropanol with 10 ml of freshly prepared 10 percent potassium iodide solution. Prepare a blank by similarly treating 10 ml of distilled water. After 1 minute, read the absorbance on a spectrophotometer at 352 nanometers. If the absorbance exceeds 0.1, the isopropanol shall not be used. Peroxides may be removed from isopropanol by redistilling, or by passage through a column of activated alumina. However, reagent-grade isopropanol with suitably low peroxide levels is readily available from commercial sources; therefore, rejection of contaminated lots may be more efficient than following the peroxide removal procedure.

3.1.5 Hydrogen Peroxide, 3 Percent. Dilute 100 ml of 30 percent hydrogen peroxide to 1 liter with deionized, distilled water. Prepare fresh daily.

3.1.6 Crushed Ice.

3.2 Sample Recovery.

3.2.1 Water. Same as 3.1.3.

3.2.2 Isopropanol, 80 Percent. Same as 3.1.4.

3.3 Analysis.

3.3.1 Water. Same as 3.1.3.

3.3.2 Isopropanol, 100 Percent.

3.3.3 Thorin Indicator. 1-(o-arsonophenylazo)-2-naphthol-3, 6-disulfonic acid, disodium salt, or equivalent. Dissolve 0.20 g in 100 ml of deionized, distilled water.

3.3.4 Barium Perchlorate (0.0100 Normal). Dissolve 1.95 g of barium perchlorate trihydrate ($Ba(ClO_4)_2 \cdot 3H_2O$) in 200 ml deionized, distilled water, and dilute to 1 liter with isopropanol; 1.22 g of barium chloride dihydrate ($BaCl_2 \cdot 2H_2O$) may be used instead of the barium perchlorate. Standardize with sulfuric acid as in Section 5.2. This solution must be protected against evaporation at all times.

3.3.5 Sulfuric Acid Standard (0.0100 N). Purchase or standardize to ±0.0002 N against 0.0100 N NaOH that has previously been standardized against primary standard potassium acid phthalate.

4. *Procedure*

4.1 Sampling.

4.1.1 Pretest Preparation. Follow the procedure outlined in Method 5, Section 4.1.1; filters should be inspected, but need not be desiccated, weighed, or identified. If the effluent gas can be considered dry, i.e., moisture free, the silica gel need not be weighed.

4.1.2 Preliminary Determinations. Follow the procedure outlined in Method 5, Section 4.1.2.

4.1.3 Preparation of Collection Train. Follow the procedure outlined in Method 5, Section 4.1.3 (except for the second paragraph and other obviously inapplicable parts) and use Figure 8-1 instead of Figure 5-1. Replace the second paragraph with: Place 100 ml of 80 percent isopropanol in the first impinger, 100 ml of 3 percent hydrogen peroxide in both the second and third impingers; retain a portion of each reagent for use as a blank solution. Place about 200 g of silica gel in the fourth impinger.

PLANT ____________

LOCATION ____________

OPERATOR ____________

DATE ____________

RUN NO. ____________

SAMPLE BOX NO. ____________

METER BOX NO. ____________

METER ΔH@ ____________

C FACTOR ____________

PITOT TUBE COEFFICIENT, Cp ____________

SCHEMATIC OF STACK CROSS SECTION

STATIC PRESSURE, mm Hg (in. Hg) ____________

AMBIENT TEMPERATURE ____________

BAROMETRIC PRESSURE ____________

ASSUMED MOISTURE, % ____________

PROBE LENGTH, m (ft) ____________

NOZZLE IDENTIFICATION NO. ____________

AVERAGE CALIBRATED NOZZLE DIAMETER, cm (in.) ____________

PROBE HEATER SETTING ____________

LEAK RATE, m^3/min, (cfm) ____________

PROBE LINER MATERIAL ____________

FILTER NO. ____________

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	VACUUM mm Hg (in. Hg)	STACK TEMPERATURE (T_S), °C (°F)	VELOCITY HEAD (ΔP_S), mm H_2O (in. H_2O)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER, mm H_2O (in. H_2O)	GAS SAMPLE VOLUME, m^3 (ft^3)	GAS SAMPLE TEMPERATURE AT DRY GAS METER		TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, °C (°F)
							INLET, °C (°F)	OUTLET, °C (°F)	
TOTAL							Avg	Avg	
AVERAGE							Avg		

Figure 8-2. Field data.

NOTE.—If moisture content is to be determined by impinger analysis, weigh each of the first three impingers (plus absorbing solution) to the nearest 0.5 g and record these weights. The weight of the silica gel (or silica gel plus container) must also be determined to the nearest 0.5 g and recorded.

4.1.4 Pretest Leak-Check Procedure. Follow the basic procedure outlined in Method 5, Section 4.1.4.1, noting that the probe heater shall be adjusted to the minimum temperature required to prevent condensation, and also that verbage such as, "* * * plugging the inlet to the filter holder * * *," shall be replaced by, "* * * plugging the inlet to the first impinger * * *." The pretest leak-check is optional.

4.1.5 Train Operation. Follow the basic procedures outlined in Method 5, Section 4.1.5, in conjunction with the following special instructions. Data shall be recorded on a sheet similar to the one in Figure 8-2. The sampling rate shall not exceed 0.030 m³/min (1.0 cfm) during the run. Periodically during the test, observe the connecting line between the probe and first impinger for signs of condensation. If it does occur, adjust the probe heater setting upward to the minimum temperature required to prevent condensation. If component changes become necessary during a run, a leak-check shall be done immediately before each change, according to the procedure outlined in Section 4.1.4.2 of Method 5 (with appropriate modifications, as mentioned in Section 4.1.4 of this method); record all leak rates. If the leakage rate(s) exceed the specified rate, the tester shall either void the run or shall plan to correct the sample volume as outlined in Section 6.3 of Method 5. Immediately after component changes, leak-checks are optional. If these leak-checks are done, the procedure outlined in Section 4.1.4.1 of Method 5 (with appropriate modifications) shall be used.

After turning off the pump and recording the final readings at the conclusion of each run, remove the probe from the stack. Conduct a post-test (mandatory) leak-check as in Section 4.1.4.3 of Method 5 (with appropriate modification) and record the leak rate. If the post-test leakage rate exceeds the specified acceptable rate, the tester shall either correct the sample volume, as outlined in Section 6.3 of Method 5, or shall void the run.

Drain the ice bath and, with the probe disconnected, purge the remaining part of the train, by drawing clean ambient air through the system for 15 minutes at the average flow rate used for sampling.

NOTE.—Clean ambient air can be provided by passing air through a charcoal filter. At the option of the tester, ambient air (without cleaning) may be used.

4.1.6 Calculation of Percent Isokinetic. Follow the procedure outlined in Method 5, Section 4.1.6.

4.2 Sample Recovery.

4.2.1 Container No. 1. If a moisture content analysis is to be done, weigh the first impinger plus contents to the nearest 0.5 g and record this weight.

Transfer the contents of the first impinger to a 250-ml graduated cylinder. Rinse the probe, first impinger, all connecting glassware before the filter, and the front half of the filter holder with 80 percent isopropanol. Add the rinse solution to the cylinder. Dilute to 250 ml with 80 percent isopropanol. Add the filter to the solution, mix, and transfer to the storage container. Protect the solution against evaporation. Mark the level of liquid on het container and identify the sample container.

4.2.2 Container No. 2. If a moisture content analysis is to be done, weigh the second and third impingers (plus contents) to the nearest 0.5 g and record these weights. Also, weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g.

Transfer the solutions from the second and third impingers to a 1000-ml graduated cylinder. Rinse all connecting glassware (including back half of filter holder) between the filter and silica gel impinger with deionized, distilled water, and add this rinse water to the cylinder. Dilute to a volume of 1000 ml with deionized, distilled water. Transfer the solution to a storage container. Mark the level of liquid on the container. Seal and identify the sample container.

4.3 Analysis.

Note the level of liquid in containers 1 and 2, and confirm whether or not any sample was lost during shipment; note this on the analytical data sheet. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results.

4.3.1 Container No. 1. Shake the container holding the isopropanol solution and the filter. If the filter breaks up, allow the fragments to settle for a few minutes before removing a sample. Pipette a 100-ml aliquot of this solution into a 250-ml Erlenmeyer flask, add 2 to 4 drops of thorin indicator, and titrate to a pink endpoint using 0.0100 N barium perchlorate. Repeat the titration with a second aliquot of sample and average the titration values. Replicate titrations must agree within 1 percent or 0.2 ml, whichever is greater.

4.3.2 Container No. 2. Thoroughly mix the solution in the container holding the contents of the second and third impingers. Pipette a 10-ml aliquot of sample into a 250-ml Erlenmeyer flask. Add ml of isopropanol, 2 to 4 drops of thorin indicator, and titrate to a pink endpoint using 0.0100 N barium perchlorate. Repeat the titration with a second aliquot of sample and average the titration values. Replicate titrations must agree within 1 percent or 0.2 ml, whichever is greater.

4.3.3 Blanks. Prepare blanks by adding 2 to 4 drops of thorin indicator to 100 ml of 80 percent isopropanol. Titrate the blanks in the same manner as the samples.

5. *Calibration*

5.1 Calibrate equipment using the procedures specified in the following sections of Method 5: Section 5.3 (metering system); Section 5.5 (temperature gauges); Section 5.7 (barometer). Note that the recommended leak-check of the metering system, described in Section 5.6 of Method 5, also applies to this method.

5.2 Standardize the barium perchlorate solution with 25 ml of standard sulfuric acid, to which 100 ml of 100 percent isopropanol has been added.

6. *Calculations*

Note.—Carry out calculations retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

6.1 Nomenclature.

A_n = Cross-sectional area of nozzle, m² (ft²).
B_{ws} = Water vapor in the gas stream, proportion by volume.
$C_{H_2SO_4}$ = Sulfuric acid (including SO_3) concentration, g/dscm (lb/dscf).
C_{SO_2} = Sulfur dioxide concentration, g/dscm (lb/dscf).
I = Percent of isokinetic sampling.
N = Normality of barium perchlorate titrant, g equivalents/liter.
P_{bar} = Barometric pressure at the sampling site, mm Hg (in. Hg).
P_s = Absolute stack gas pressure, mm Hg (in. Hg).
P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).
T_m = Average absolute dry gas meter temperature (see Figure 8-2), ° K (° R).
T_s = Average absolute stack gas temperature (see Figure 8-2), ° K (° R).
T_{std} = Standard absolute temperature, 293° K (528° R).
V_a = Volume of sample aliquot titrated, 100 ml for H_2SO_4 and 10 ml for SO_2.
V_{lc} = Total volume of liquid collected in impingers and silica gel, ml.
V_m = Volume of gas sample as measured by dry gas meter, dcm (dcf).
$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter corrected to standard conditions, dscm (dscf).
v_s = Average stack gas velocity, calculated by Method 2, Equation 2-9, using data obtained from Method 8, m/sec (ft/sec).
V_{soln} = Total volume of solution in which the sulfuric acid or sulfur dioxide sample is contained, 250 ml or 1,000 ml, respectively.
V_t = Volume of barium perchlorate titrant used for the sample, ml.
V_{tb} = Volume of barium perchlorate titrant used for the blank, ml.
Y = Dry gas meter calibration factor.
ΔH = Average pressure drop across orifice meter, mm (in.) H_2O.
θ = Total sampling time, min.
13.6 = Specific gravity of mercury.
60 = sec/min.
100 = Conversion to percent.

6.2 Average dry gas meter temperature and average orifice pressure drop. See data sheet (Figure 8-2).

6.3 Dry Gas Volume. Correct the sample volume measured by the dry gas meter to standard conditions (20° C and 760 mm Hg or 68° F and 29.92 in. Hg) by using Equation 8-1.

$$V_{m(std)} = V_m Y \left(\frac{T_{std}}{T_m}\right) \frac{P_{bar} + \left(\frac{\Delta H}{13.6}\right)}{P_{std}}$$

$$= K_1 V_m Y \frac{P_{bar} + (\Delta H/13.6)}{T_m}$$

Equation 8-1

where:
K_1 = 0.3858 °K/mm Hg for metric units
= 17.64 °R/in. Hg for English units.

NOTE.—If the leak rate observed during any mandatory leak-checks exceeds the specified acceptable rate, the tester shall either correct the value of V_m in Equation 8-1 (as described in Section 6.3 of Method 5), or shall invalidate the test run.

6.4 Volume of Water Vapor and Moisture Content. Calculate the volume of water vapor using Equation 5-2 of Method 5; the weight of water collected in the impingers and silica gel can be directly converted to milliliters (the specific gravity of water is 1 g/ml). Calculate the moisture content of the stack gas, using Equation 5-3 of Method 5. The "Note" in Section 6.5 of Method 5 also applies to this method. Note that if the effluent gas stream can be considered dry, the volume of water vapor and moisture content need not be calculated.

6.5 Sulfuric acid mist (including SO_3) concentration.

$$C_{H_2SO_4} = K_2 \frac{N(V_t - V_{tb}) \left(\frac{V_{soln}}{V_a}\right)}{V_{m(std)}}$$

Equation 8-2

where:
K_2 = 0.04904 g/milliequivalent for metric units.
= 1.081×10^{-4} lb/meq for English units.

6.6 Sulfur dioxide concentration.

$$C_{SO_2} = K_3 \frac{N(V_t - V_{tb}) \left(\frac{V_{soln}}{V_a}\right)}{V_{m(std)}}$$

Equation 8-3

where:
K_3 = 0.03203 g/meq for metric units.
= 7.061×10^{-4} lb/meq for English units.

6.7 Isokinetic Variation.

6.7.1 Calculation from raw data.

$$I = \frac{100\, T_s [K_4 V_{lc} + (V_m/T_m) P_{bar} + \Delta H/13.6)]}{60\, \theta V_s P_s A_n}$$

Equation 8-4

where:
K_4 = 0.003464 mm Hg-m³/ml-°K for metric units.
= 0.002676 in. Hg-ft³/ml-°R for English units.

6.7.2 Calculation from intermediate values.

$$I = \frac{T_s V_{m(std)} P_{std}\, 100}{T_{std} v_s \theta A_n P_s 60 (1 - B_{ws})}$$

$$= K_5 \frac{T_s V_{m(std)}}{P_s v_s A_n \theta (1 - B_{ws})}$$

Equation 8-5

where:
K_5 = 4.320 for metric units.
= 0.09450 for English units.

6.8 Acceptable Results. If 90 percent ≤I ≤110 percent, the results are acceptable. If the results are low in comparison to the standards and I is beyond the acceptable range, the Administrator may opt to accept the results. Use Citation 4 in the Bibliography of Method 5 to make judgments. Otherwise, reject the results and repeat the test.

7. *Bibliography*

1. Atmospheric Emissions from Sulfuric Acid Manufacturing Processes. U.S. DHEW, PHS, Division of Air Pollution. Public Health Service Publication No. 999-AP-13. Cincinnati, Ohio. 1965.

2. Corbett, P. F. The Determination of SO_2 and SO_3 in Flue Gases. Journal of the Institute of Fuel. 24:237-243. 1961.

3. Martin, Robert M. Construction Details of Isokinetic Source Sampling Equipment. Environmental Protection Agency. Research Triangle Park, N.C. Air Pollution Control Office Publication No. APTD-0581. April, 1971.

4. Patton, W. F. and J. A. Brink, Jr. New Equipment and Techniques for Sampling Chemical Process Gases. Journal of Air Pollution Control Association. 13:162. 1963.

5. Rom, J. J. Maintenance, Calibration, and Operation of Isokinetic Source-Sampling Equipment. Office of Air Programs, Environmental Protection Agency. Research Triangle Park, N.C. APTD-0576. March, 1972.

6. Hamil, H. F. and D. E. Camann. Collaborative Study of Method for Determination of Sulfur Dioxide Emissions from Stationary Sources (Fossil Fuel-Fired Steam Generators). Environmental Protection Agency. Research Triangle Park, N.C. EPA-650/4-74-024. December, 1973.

7. Annual Book of ASTM Standards. Part 31; Water, Atmospheric Analysis. pp. 40-42. American Society for Testing and Materials. Philadelphia, Pa. 1974.

METHOD 9—VISUAL DETERMINATION OF THE OPACITY OF EMISSIONS FROM STATIONARY SOURCES

Many stationary sources discharge visible emissions into the atmosphere; these emissions are usually in the shape of a plume. This method involves the determination of plume opacity by qualified observers. The method includes procedures for the training and certification of observers, and procedures to be used in the field for determination of plume opacity. The appearance of a plume as viewed by an observer depends upon a number of variables, some of which may be controllable and some of which may not be controllable in the field. Variables which can be controlled to an extent to which they no longer exert a significant influence upon plume appearance include: Angle of the observer with respect to the plume; angle of the observer with respect to the sun; point of observation of attached and detached steam plume; and angle of the observer with respect to a plume emitted from a rectangular stack with a large length to width ratio. The method includes specific criteria applicable to these variables.

Other variables which may not be controllable in the field are luminescence and color contrast between the plume and the background against which the plume is viewed. These variables exert an influence upon the appearance of a plume as viewed by an observer, and can affect the ability of the observer to accurately assign opacity values to the observed plume. Studies of the theory of plume opacity and field studies have demonstrated that a plume is most visible and presents the greatest apparent opacity when viewed against a contrasting background. It follows from this, and is confirmed by field trials, that the opacity of a plume, viewed under conditions where a contrasting background is present can be assigned with the greatest degree of accuracy. However, the potential for a positive error is also the greatest when a plume is viewed under such contrasting conditions. Under conditions presenting a less contrasting background, the apparent opacity of a plume is less and approaches zero as the color and luminescence contrast decrease toward zero. As a result, significant negative bias and negative errors can be made when a plume is viewed under less contrasting conditions. A negative bias decreases rather than increases the possibility that a plant operator will be cited for a violation of opacity standards due to observer error.

Studies have been undertaken to determine the magnitude of positive errors which can be made by qualified observers while reading plumes under contrasting conditions and using the procedures set forth in this method. The results of these studies (field trials) which involve a total of 769 sets of 25 readings each are as follows:

(1) For black plumes (133 sets at a smoke generator), 100 percent of the sets were read with a positive error[1] of less than 7.5 percent opacity; 99 percent were read with a positive error of less than 5 percent opacity.

(2) For white plumes (170 sets at a smoke generator, 168 sets at a coal-fired power plant, 298 sets at a sulfuric acid plant), 99 percent of the sets were read with a positive error of less than 7.5 percent opacity; 95 percent were read with a positive error of less than 5 percent opacity.

The positive observational error associated with an average of twenty-five readings is therefore established. The accuracy of the method must be taken into account when determining possible violations of applicable opacity standards.

1. *Principle and applicability.*

1.1 Principle. The opacity of emissions from stationary sources is determined visually by a qualified observer.

1.2 Applicability. This method is applicable for the determination of the opacity of emissions from stationary sources pursuant to § 60.11(b) and for qualifying observers for visually determining opacity of emissions.

2. *Procedures*. The observer qualified in accordance with paragraph 3 of this method shall use the following procedures for visually determining the opacity of emissions:

2.1 Position. The qualified observer shall stand at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to his back. Consistent with maintaining the above requirement, the observer shall, as much as possible, make his observations from a position such that his line of vision is approximately perpendicular to the plume direction, and when observing opacity of emissions from rectangular outlets (e.g. roof monitors, open baghouses, noncircular stacks), approximately perpendicular to the longer axis of the outlet. The observer's line of sight should not include more than one plume at a time when multiple stacks are involved, and in any case the observer should make his observations with his line of sight perpendicular to the longer axis of such a set of multiple stacks (e.g. stub stacks on baghouses).

2.2 Field records. The observer shall record the name of the plant, emission location, type facility, observer's name and affiliation, and the date on a field data sheet (Figure 9–1). The time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky condition (presence and color of clouds), and plume background are recorded on a field data sheet at the time opacity readings are initiated and completed.

2.3 Observations. Opacity observations shall be made at the point of greatest opacity in that portion of the plume where condensed water vapor is not present. The observer shall not look continuously at the plume, but instead shall observe the plume momentarily at 15-second intervals.

2.3.1 Attached steam plumes. When condensed water vapor is present within the plume as it emerges from the emission outlet, opacity observations shall be made beyond the point in the plume at which condensed water vapor is no longer visible. The observer shall record the approximate distance from the emission outlet to the point in the plume at which the observations are made.

2.3.2 Detached steam plume. When water vapor in the plume condenses and becomes visible at a distinct distance from the emission outlet, the opacity of emissions should be evaluated at the emission outlet prior to the condensation of water vapor and the formation of the steam plume.

2.4 Recording observations. Opacity observations shall be recorded to the nearest 5 percent at 15-second intervals on an observational record sheet. (See Figure 9–2 for an example.) A minimum of 24 observations shall be recorded. Each momentary observation recorded shall be deemed to represent the average opacity of emissions for a 15-second period.

2.5 Data Reduction. Opacity shall be determined as an average of 24 consecutive observations recorded at 15-second intervals. Divide the observations recorded on the record sheet into sets of 24 consecutive observations. A set is composed of any 24 consecutive observations. Sets need not be consecutive in time and in no case shall two sets overlap. For each set of 24 observations, calculate the average by summing the opacity of the 24 observations and dividing this sum by 24. If an applicable standard specifies an averaging time requiring more than 24 observations, calculate the average for all observations made during the specified time period. Record the average opacity on a record sheet. (See Figure 9–1 for an example.)

3. *Qualifications and testing*.

3.1 Certification requirements. To receive certification as a qualified observer, a candidate must be tested and demonstrate the ability to assign opacity readings in 5 percent increments to 25 different black plumes and 25 different white plumes, with an error not to exceed 15 percent opacity on any one reading and an average error not to exceed 7.5 percent opacity in each category. Candidates shall be tested according to the procedures described in paragraph 3.2. Smoke generators used pursuant to paragraph 3.2 shall be equipped with a smoke meter which meets the requirements of paragraph 3.3.

The certification shall be valid for a period of 6 months, at which time the qualification procedure must be repeated by any observer in order to retain certification.

3.2 Certification procedure. The certification test consists of showing the candidate a complete run of 50 plumes—25 black plumes and 25 white plumes—generated by a smoke generator. Plumes within each set of 25 black and 25 white runs shall be presented in random order. The candidate assigns an opacity value to each plume and records his observation on a suitable form. At the completion of each run of 50 readings, the score of the candidate is determined. If a candidate fails to qualify, the complete run of 50 readings must be repeated in any retest. The smoke test may be administered as part of a smoke school or training program, and may be preceded by training or familiarization runs of the smoke generator during which candidates are shown black and white plumes of known opacity.

3.3 Smoke generator specifications. Any smoke generator used for the purposes of paragraph 3.2 shall be equipped with a smoke meter installed to measure opacity across the diameter of the smoke generator stack. The smoke meter output shall display in-stack opacity based upon a pathlength equal to the stack exit diameter, on a full 0 to 100 percent chart recorder scale. The smoke meter optical design and performance shall meet the specifications shown in Table 9–1. The smoke meter shall be calibrated as prescribed in paragraph 3.3.1 prior to the conduct of each smoke reading test. At the completion of each test, the zero and span drift shall be checked and if the drift exceeds ±1 percent opacity, the condition shall be corrected prior to conducting any subsequent test runs. The smoke meter shall be demonstrated, at the time of installation, to meet the specifications listed in Table 9–1. This demonstration shall be repeated following any subsequent repair or replacement of the photocell or associated electronic circuitry including the chart recorder or output meter, or every 6 months, whichever occurs first.

3.3.1 Calibration. The smoke meter is calibrated after allowing a minimum of 30 minutes warmup by alternately producing simulated opacity of 0 percent and 100 percent. When stable response at 0 percent or 100 percent is noted, the smoke meter is adjusted to produce an output of 0 percent or 100 percent, as appropriate. This calibration shall be repeated until stable 0 percent and 100 percent readings are produced without adjustment. Simulated 0 percent and 100 percent opacity values may be produced by alternately switching the power to the light source on and off while the smoke generator is not producing smoke.

---

[1] For a set, positive error=average opacity determined by observers' 25 observations—average opacity determined from transmissometer's 25 recordings.

TABLE 9-1—SMOKE METER DESIGN AND PERFORMANCE SPECIFICATIONS

Parameter:	*Specification*
a. Light source	Incandescent lamp operated at nominal rated voltage.
b. Spectral response of photocell.	Photopic (daylight spectral response of the human eye—reference 4.3).
c. Angle of view	15° maximum total angle.
d. Angle of projection.	15° maximum total angle.
e. Calibration error.	±3% opacity, maximum.
f. Zero and span drift.	±1% opacity, 30 minutes.
g. Response time	≤5 seconds.

3.3.2 Smoke meter evaluation. The smoke meter design and performance are to be evaluated as follows:

3.3.2.1 Light source. Verify from manufacturer's data and from voltage measurements made at the lamp, as installed, that the lamp is operated within ±5 percent of the nominal rated voltage.

3.3.2.2 Spectral response of photocell. Verify from manufacturer's data that the photocell has a photopic response; i.e., the spectral sensitivity of the cell shall closely approximate the standard spectral-luminosity curve for photopic vision which is referenced in (b) of Table 9-1.

3.3.2.3 Angle of view. Check construction geometry to ensure that the total angle of view of the smoke plume, as seen by the photocell, does not exceed 15°. The total angle of view may be calculated from: $\theta=2 \tan^{-1} d/2L$, where θ=total angle of view; d=the sum of the photocell diameter+the diameter of the limiting aperture; and L=the distance from the photocell to the limiting aperture. The limiting aperture is the point in the path between the photocell and the smoke plume where the angle of view is most restricted. In smoke generator smoke meters this is normally an orifice plate.

3.3.2.4 Angle of projection. Check construction geometry to ensure that the total angle of projection of the lamp on the smoke plume does not exceed 15°. The total angle of projection may be calculated from: $\theta=2 \tan^{-1} d/2L$, where θ= total angle of projection; d= the sum of the length of the lamp filament + the diameter of the limiting aperture; and L= the distance from the lamp to the limiting aperture.

3.3.2.5 Calibration error. Using neutral-density filters of known opacity, check the error between the actual response and the theoretical linear response of the smoke meter. This check is accomplished by first calibrating the smoke meter according to 3.3.1 and then inserting a series of three neutral-density filters of nominal opacity of 20, 50, and 75 percent in the smoke meter pathlength. Filters calibarted within ±2 percent shall be used. Care should be taken when inserting the filters to prevent stray light from affecting the meter. Make a total of five nonconsecutive readings for each filter. The maximum error on any one reading shall be 3 percent opacity.

3.3.2.6 Zero and span drift. Determine the zero and span drift by calibrating and operating the smoke generator in a normal manner over a 1-hour period. The drift is measured by checking the zero and span at the end of this period.

3.3.2.7 Response time. Determine the response time by producing the series of five simulated 0 percent and 100 percent opacity values and observing the time required to reach stable response. Opacity values of 0 percent and 100 percent may be simulated by alternately switching the power to the light source off and on while the smoke generator is not operating.

4. *References.*

4.1 Air Pollution Control District Rules and Regulations, Los Angeles County Air Pollution Control District, Regulation IV, Prohibitions, Rule 50.

4.2 Weisburd, Melvin I., Field Operations and Enforcement Manual for Air, U.S. Environmental Protection Agency, Research Triangle Park, N.C., APTD-1100, August 1972. pp. 4.1–4.36.

4.3 Condon, E. U., and Odishaw, H., Handbook of Physics, McGraw-Hill Co., N.Y., N.Y., 1958, Table 3.1, p. 6–52.

FIGURE 9-1
RECORD OF VISUAL DETERMINATION OF OPACITY

PAGE___of___

COMPANY________________
LOCATION________________
TEST NUMBER________________
DATE________________
TYPE FACILITY________________
CONTROL DEVICE________________

HOURS OF OBSERVATION________________
OBSERVER________________
OBSERVER CERTIFICATION DATE________________
OBSERVER AFFILIATION________________
POINT OF EMISSIONS________________
HEIGHT OF DISCHARGE POINT________________

CLOCK TIME	Initial			Final
OBSERVER LOCATION Distance to Discharge				
Direction from Discharge				
Height of Observation Point				
BACKGROUND DESCRIPTION				
WEATHER CONDITIONS Wind Direction				
Wind Speed				
Ambient Temperature				
SKY CONDITIONS (clear, overcast, % clouds, etc.)				
PLUME DESCRIPTION Color				
Distance Visible				
OTHER INFORMATION				

SUMMARY OF AVERAGE OPACITY

Set Number	Time	Opacity	
	Start--End	Sum	Average

Readings ranged from ____ to ____ % opacity

The source was/was not in compliance with ____ at the time evaluation was made.

FIGURE 9-2 OBSERVATION RECORD PAGE ___ OF ___

COMPANY ______________
LOCATION ______________
TEST NUMBER ______________
DATE ______________

OBSERVER ______________
TYPE FACILITY ______________
POINT OF EMISSIONS ______________

Hr.	Min.	Seconds				STEAM PLUME (check if applicable)		COMMENTS
		0	15	30	45	Attached	Detached	
	0							
	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							
	17							
	18							
	19							
	20							
	21							
	22							
	23							
	24							
	25							
	26							
	27							
	28							
	29							

FIGURE 9-2 OBSERVATION RECORD
(Continued)
PAGE ___ OF ___

COMPANY ______________
LOCATION ______________
TEST NUMBER ______________
DATE ______________

OBSERVER ______________
TYPE FACILITY ______________
POINT OF EMISSIONS ______________

Hr.	Min.	Seconds				STEAM PLUME (check if applicable)		COMMENTS
		0	15	30	45	Attached	Detached	
	30							
	31							
	32							
	33							
	34							
	35							
	36							
	37							
	38							
	39							
	40							
	41							
	42							
	43							
	44							
	45							
	46							
	47							
	48							
	49							
	50							
	51							
	52							
	53							
	54							
	55							
	56							
	57							
	58							
	59							

[FR Doc.74-26150 Filed 11-11-74;8:45 am]

APPENDIX B—PERFORMANCE SPECIFICATIONS

Performance Specification 1—Performance specifications and specification test procedures for transmissometer systems for continuous measurement of the opacity of stack emissions.

1. Principle and Applicability.

1.1 Principle. The opacity of particulate matter in stack emissions is measured by a continuously operating emission measurement system. These systems are based upon the principle of transmissometry which is a direct measurement of the attenuation of visible radiation (opacity) by particulate matter in a stack effluent. Light having specific spectral characteristics is projected from a lamp across the stack of a pollutant source to a light sensor. The light is attenuated due to absorption and scatter by the particulate matter in the effluent. The percentage of visible light attenuated is defined as the opacity of the emission. Transparent stack emissions that do not attenuate light will have a transmittance of 100 or an opacity of 0. Opaque stack emissions that attenuate all of the visible light will have a transmittance of 0 or an opacity of 100 percent. The transmissometer is evaluated by use of neutral density filters to determine the precision of the continuous monitoring system. Tests of the system are performed to determine zero drift, calibration drift, and response time characteristics of the system.

1.2 Applicability. This performance specification is applicable to the continuous monitoring systems specified in the subparts for measuring opacity of emissions. Specifications for continuous measurement of visible emissions are given in terms of design, performance, and installation parameters. These specifications contain test procedures, installation requirements, and data computation procedures for evaluating the acceptability of the continuous monitoring systems subject to approval by the Administrator.

2. Apparatus.

2.1 Calibrated Filters. Optical filters with neutral spectral characteristics and known optical densities to visible light or screens known to produce specified optical densities. Calibrated filters with accuracies certified by the manufacturer to within ±3 percent opacity shall be used. Filters required are low, mid, and high-range filters with nominal optical densities as follows when the transmissometer is spanned at opacity levels specified by applicable subparts:

Span value (percent opacity)	Calibrated filter optical densities with equivalent opacity in parenthesis		
	Low-range	Mid-range	High-range
50	0.1 (20)	0.2 (37)	0.3 (50)
60	.1 (20)	.2 (37)	.3 (50)
70	.1 (20)	.3 (50)	.4 (60)
80	.1 (20)	.3 (50)	.6 (75)
90	.1 (20)	.4 (60)	.7 (80)
100	.1 (20)	.4 (60)	.9 (87½)

It is recommended that filter calibrations be checked with a well-collimated photopic transmissometer of known linearity prior to use. The filters shall be of sufficient size to attenuate the entire light beam of the transmissometer.

2.2 Data Recorder. Analog chart recorder or other suitable device with input voltage range compatible with the analyzer system output. The resolution of the recorder's data output shall be sufficient to allow completion of the test procedures within this specification.

2.3 Opacity measurement System. An in-stack transmissometer (folded or single path) with the optical design specifications designated below, associated control units and apparatus to keep optical surfaces clean.

3. Definitions.

3.1 Continuous Monitoring System. The total equipment required for the determination of pollutant opacity in a source effluent. Continuous monitoring systems consist of major subsystems as follows:

3.1.1 Sampling Interface. The portion of a continuous monitoring system for opacity that protects the analyzer from the effluent.

3.1.2 Analyzer. That portion of the continuous monitoring system which senses the pollutant and generates a signal output that is a function of the pollutant opacity.

3.1.3 Data Recorder. That portion of the continuous monitoring system that processes the analyzer output and provides a permanent record of the output signal in terms of pollutant opacity.

3.2 Transmissometer. The portions of a continuous monitoring system for opacity that include the sampling interface and the analyzer.

3.3 Span. The value of opacity at which the continuous monitoring system is set to produce the maximum data display output. The span shall be set at an opacity specified in each applicable subpart.

3.4 Calibration Error. The difference between the opacity reading indicated by the continuous monitoring system and the known values of a series of test standards. For this method the test standards are a series of calibrated optical filters or screens.

3.5 Zero Drift. The change in continuous monitoring system output over a stated period of time of normal continuous operation when the pollutant concentration at the time of the measurements is zero.

3.6 Calibration Drift. The change in the continuous monitoring system output over a stated period of time of normal continuous operation when the pollutant concentration at the time of the measurements is the same known upscale value.

3.7 System Response. The time interval from a step change in opacity in the stack at the input to the continuous monitoring system to the time at which 95 percent of the corresponding final value is reached as displayed on the continuous monitoring system data recorder.

3.8 Operational Test Period. A minimum period of time over which a continuous monitoring system is expected to operate within certain performance specifications without unscheduled maintenance, repair, or adjustment.

3.9 Transmittance. The fraction of incident light that is transmitted through an optical medium of interest.

3.10 Opacity. The fraction of incident light that is attenuated by an optical medium of interest. Opacity (O) and transmittance (T) are related as follows:

$$O=1-T$$

3.11 Optical Density. A logarithmic measure of the amount of light that it attenuated by an optical medium of interest. Optical density (D) is related to the transmittance and opacity as follows:

$D=-\log_{10}T$

$D=-\log_{10}(1-O)$

3.12 Peak Optical Response. The wavelength of maximum sensitivity of the instrument.

3.13 Mean Spectral Response. The wavelength which bisects the total area under the curve obtained pursuant to paragraph 9.2.1.

3.14 Angle of View. The maximum (total) angle of radiation detection by the photodetector assembly of the analyzer.

3.15 Angle of Projection. The maximum (total) angle that contains 95 percent of the radiation projected from the lamp assembly of the analyzer.

3.16 Pathlength. The depth of effluent in the light beam between the receiver and the transmitter of the single-pass transmissometer, or the depth of effluent between the transceiver and reflector of a double-pass transmissometer. Two pathlengths are referenced by this specification:

3.16.1 Monitor Pathlength. The depth of effluent at the installed location of the continuous monitoring system.

3.16.2 Emission Outlet Pathlength. The depth of effluent at the location emissions are released to the atmosphere.

4. Installation Specification.

4.1 Location. The transmissometer must be located across a section of duct or stack that will provide a particulate matter flow through the optical volume of the transmissometer that is representative of the particulate matter flow through the duct or stack. It is recommended that the monitor pathlength or depth of effluent for the transmissometer include the entire diameter of the duct or stack. In installations using a shorter pathlength, extra caution must be used in determining the measurement location representative of the particulate matter flow through the duct or stack.

4.1.1 The transmissometer location shall be downstream from all particulate control equipment.

4.1.2 The transmissometer shall be located as far from bends and obstructions as practical.

4.1.3 A transmissometer that is located in the duct or stack following a bend shall be installed in the plane defined by the bend where possible.

4.1.4 The transmissometer should be installed in an accessible location.

4.1.5 When required by the Administrator, the owner or operator of a source must demonstrate that the transmissometer is located in a section of duct or stack where a representative particulate matter distribution exists. The determination shall be accomplished by examining the opacity profile of the effluent at a series of positions across the duct or stack while the plant is in operation at maximum or reduced operating rates or by other tests acceptable to the Administrator.

4.2 Slotted Tube. Installations that require the use of a slotted tube shall use a slotted tube of sufficient size and blackness so as not to interfere with the free flow of effluent through the entire optical volume of the transmissometer or reflect light into the transmissometer photodetector. Light reflections may be prevented by using blackened baffles within the slotted tube to prevent the lamp radiation from impinging upon the tube walls, by restricting the angle of projection of the light and the angle of view of the photodetector assembly to less than the cross-sectional area of the slotted tube, or by other methods. The owner or operator must show that the manufacturer of the monitoring system has used appropriate methods to minimize light reflections for systems using slotted tubes.

4.3 Data Recorder Output. The continuous monitoring system output shall permit expanded display of the span opacity on a standard 0 to 100 percent scale. Since all opacity standards are based on the opacity of the effluent exhausted to the atmosphere, the system output shall be based upon the emission outlet pathlength and permanently recorded. For affected facilities whose monitor pathlength is different from the facility's emission outlet pathlength, a graph shall be provided with the installation to show the relationships between the continuous monitoring system recorded opacity based upon the emission outlet pathlength and the opacity of the effluent at the analyzer location (monitor pathlength). Tests for measurement of opacity that are required by this performance specification are based upon the monitor pathlength. The graph necessary to convert the data recorder output to the monitor pathlength basis shall be established as follows:

$$\log(1-O_1)=(l_1/l_2)\log(1-O_2)$$

where:

O_1 = the opacity of the effluent based upon l_1.
O_2 = the opacity of the effluent based upon l_2.
l_1 = the emission outlet pathlength.
l_2 = the monitor pathlength.

5. Optical Design Specifications.

The optical design specifications set forth in Section 6.1 shall be met in order for a measurement system to comply with the requirements of this method.

6. Determination of Conformance with Design Specifications.

6.1 The continuous monitoring system for measurement of opacity shall be demonstrated to conform to the design specifications set forth as follows:

6.1.1 Peak Spectral Response. The peak spectral response of the continuous monitoring systems shall occur between 500 nm and 600 nm. Response at any wavelength below 400 nm or above 700 nm shall be less than 10 percent of the peak response of the continuous monitoring system.

6.1.2 Mean Spectral Response. The mean spectral response of the continuous monitoring system shall occur between 500 nm and 600 nm.

6.1.3 Angle of View. The total angle of view shall be no greater than 5 degrees.

6.1.4 Angle of Projection. The total angle of projection shall be no greater than 5 degrees.

6.2 Conformance with the requirements of section 6.1 may be demonstrated by the owner or operator of the affected facility by testing each analyzer or by obtaining a certificate of conformance from the instrument manufacturer. The certificate must certify that at least one analyzer from each month's production was tested and satisfactorily met all applicable requirements. The certificate must state that the first analyzer randomly sampled met all requirements of paragraph 6 of this specification. If any of the requirements were not met, the certificate must show that the entire month's analyzer production was resampled according to the military standard 105D sampling procedure (MIL-STD-105D) inspection level II; was retested for each of the applicable requirements under paragraph 6 of this specification; and was determined to be acceptable under MIL-STD-105D procedures. The certificate of conformance must show the results of each test performed for the analyzers sampled during the month the analyzer being installed was produced.

6.3 The general test procedures to be followed to demonstrate conformance with Section 6 requirements are given as follows: (These procedures will not be applicable to all designs and will require modification in some cases. Where analyzer and optical design is certified by the manufacturer to conform with the angle of view or angle of projection specifications, the respective procedures may be omitted.)

6.3.1 Spectral Response. Obtain spectral data for detector, lamp, and filter components used in the measurement system from their respective manufacturers.

6.3.2 Angle of View. Set the received up as specified by the manufacturer. Draw an arc with radius of 3 meters. Measure the receiver response to a small (less than 3 centimeters) non-directional light source at 5-centimeter intervals on the arc for 26 centimeters on either side of the detector centerline. Repeat the test in the vertical direction.

6.3.3 Angle of Projection. Set the projector up as specified by the manufacturer. Draw an arc with radius of 3 meters. Using a small photoelectric light detector (less than 3 centimeters), measure the light intensity at 5-centimeter intervals on the arc for 26 centimeters on either side of the light source centerline of projection. Repeat the test in the vertical direction.

7. Continuous Monitoring System Performance Specifications.

The continuous monitoring system shall meet the performance specifications in Table 1-1 to be considered acceptable under this method.

TABLE 1-1.—*Performance specifications*

Parameter	*Specifications*
a. Calibration error	<3 pct opacity [1]
b. Zero drift (24 h)	<2 pct opacity [1]
c. Calibration drift (24 h)	<2 pct opacity [1]
d. Response time	10 s (maximum)
e. Operational test period	168 h.

[1] Expressed as sum of absolute mean value and the 95 pct confidence interval of a series of tests.

8. Performance Specification Test Procedures. The following test procedures shall be used to determine conformance with the requirements of paragraph 7:

8.1 Calibration Error and Response Time Test. These tests are to be performed prior to installation of the system on the stack and may be performed at the affected facility or at other locations provided that proper notification is given. Set up and calibrate the measurement system as specified by the manufacturer's written instructions for the monitor pathlength to be used in the installation. Span the analyzer as specified in applicable subparts.

8.1.1 Calibration Error Test. Insert a series of calibration filters in the transmissometer path at the midpoint. A minimum of three calibration filters (low, mid, and high-range) selected in accordance with the table under paragraph 2.1 and calibrated within 3 percent must be used. Make a total of five nonconsecutive readings for each filter. Record the measurement system output readings in percent opacity. (See Figure 1-1.)

8.1.2 System Response Test. Insert the high-range filter in the transmissometer path five times and record the time required for the system to respond to 95 percent of final zero and high-range filter values. (See Figure 1-2.)

8.2 Field Test for Zero Drift and Calibration Drift. Install the continuous monitoring system on the affected facility and perform the following alignments:

8.2.1 Preliminary Alignments. As soon as possible after installation and once a year thereafter when the facility is not in operation, perform the following optical and zero alignments:

8.2.1.1 Optical Alignment. Align the light beam from the transmissometer upon the optical surfaces located across the effluent (i.e., the retroflector or photodetector as applicable) in accordance with the manufacturer's instructions.

8.2.1.2 Zero Alignment. After the transmissometer has been optically aligned and the transmissometer mounting is mechanically stable (i.e., no movement of the mounting due to thermal contraction of the stack, duct, etc.) and a clean stack condition has been determined by a steady zero opacity condition, perform the zero alignment. This alignment is performed by balancing the continuous monitor system response so that any simulated zero check coincides with an actual zero check performed across the monitor pathlength of the clean stack.

8.2.1.3 Span. Span the continuous monitoring system at the opacity specified in subparts and offset the zero setting at least 10 percent of span so that negative drift can be quantified.

8.2.2. Final Alignments. After the preliminary alignments have been completed and the affected facility has been started up and reaches normal operating temperature, recheck the optical alignment in accordance with 8.2.1.1 of this specification. If the alignment has shifted, realign the optics, record any detectable shift in the opacity measured by the system that can be attributed to the optical realignment, and notify the Administrator. This condition may not be objectionable if the affected facility operates within a fairly constant and adequately narrow range of operating temperatures that does not produce significant shifts in optical alignment during normal operation of the facility. Under circumstances where the facility operations produce fluctuations in the effluent gas temperature that result in significant misalignments, the Administrator may require improved mounting structures or another location for installation of the transmissometer.

8.2.3 Conditioning Period. After completing the post-startup alignments, operate the system for an initial 168-hour conditioning period in a normal operational manner.

8.2.4 Operational Test Period. After completing the conditioning period, operate the system for an additional 168-hour period retaining the zero offset. The system shall monitor the source effluent at all times except when being zeroed or calibrated. At 24-hour intervals the zero and span shall be checked according to the manufacturer's instructions. Minimum procedures used shall provide a system check of the analyzer internal mirrors and all electronic circuitry including the lamp and photodetector assembly and shall include a procedure for producing a simulated zero opacity condition and a simulated upscale (span) opacity condition as viewed by the receiver. The manufacturer's written instructions may be used providing that they equal or exceed these minimum procedures. Zero and span the transmissometer, clean all optical surfaces exposed to the effluent, realign optics, and make any necessary adjustments to the calibration of the system daily. These zero and calibration adjustments and optical realignments are allowed only at 24-hour intervals or at such shorter intervals as the manufacturer's written instructions specify. Automatic corrections made by the measurement system without operator intervention are allowable at any time. The magnitude of any zero or span drift adjustments shall be recorded. During this 168-hour operational test period, record the following at 24-hour intervals: (a) the zero reading and span readings after the system is calibrated (these readings should be set at the same value at the beginning of each 24-hour period); (b) the zero reading after each 24 hours of operation, but before cleaning and adjustment; and (c) the span reading after cleaning and zero adjustment, but before span adjustment. (See Figure 1-3.)

9. Calculation, Data Analysis, and Reporting.

9.1 Procedure for Determination of Mean Values and Confidence Intervals.

9.1.1 The mean value of the data set is calculated according to equation 1-1.

$$\bar{x}=\frac{1}{n}\sum_{i=1}^{n}x_i \qquad \text{Equation 1-1}$$

where x_i = absolute value of the individual measurements.

Σ = sum of the individual values.
$\bar{x}$ = mean value, and
n = number of data points.

9.1.2 The 95 percent confidence interval (two-sided) is calculated according to equation 1-2:

$$C.I._{95}=\frac{t_{.975}}{n\sqrt{n-1}}\sqrt{n(\Sigma x_i^2)-(\Sigma x_i)^2} \qquad \text{Equation 1-2}$$

where

Σx_i = sum of all data points,
$t_{.975} = t_1-\alpha/2$, and
$C.I._{95}$ = 95 percent confidence interval estimate of the average mean value.

The values in this table are already corrected for n-1 degrees of freedom. Use n equal to the number of samples as data points.

Values for $t_{.975}$

n	$t_{.975}$	n	$t_{.975}$
2	12.706	10	2.262
3	4.303	11	2.228
4	3.182	12	2.201
5	2.776	13	2.179
6	2.571	14	2.160
7	2.447	15	2.145
8	2.365	16	2.131
9	2.306		

9.2 Data Analysis and Reporting.

9.2.1 Spectral Response. Combine the spectral data obtained in accordance with paragraph 6.3.1 to develop the effective spectral response curve of the transmissometer. Report the wavelength at which the peak response occurs, the wavelength at which the mean response occurs, and the maximum response at any wavelength below 400 nm and above 700 nm expressed as a percentage of the peak response as required under paragraph 6.2.

9.2.2 Angle of View. Using the data obtained in accordance with paragraph 6.3.2, calculate the response of the receiver as a function of viewing angle in the horizontal and vertical directions (26 centimeters of arc with a radius of 3 meters equal 5 degrees). Report relative angle of view curves as required under paragraph 6.2.

9.2.3 Angle of Projection. Using the data obtained in accordance with paragraph 6.3.3, calculate the response of the photoelectric detector as a function of projection angle in the horizontal and vertical directions. Report relative angle of projection curves as required under paragraph 6.2.

9.2.4 Calibration Error. Using the data from paragraph 8.1 (Figure 1-1), subtract the known filter opacity value from the value shown by the measurement system for each of the 15 readings. Calculate the mean and 95 percent confidence interval of the five different values at each test filter value according to equations 1-1 and 1-2. Report the sum of the absolute mean difference and the 95 percent confidence interval for each of the three test filters.

Low Range ____% opacity
Span Value _____% opacity

Mid Range ___% opacity

High Range ___% opacity

Date of Test ______________ Location of Test ______________

Calibrated Filter[1]	Analyzer Reading % Opacity	Differences[2] % Opacity
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

	Low	Mid	High
Mean difference	___	___	___
Confidence interval	___	___	___
Calibration error = Mean Difference[3] + C.I.	___	___	___

---

[1] Low, mid or high range

[2] Calibration filter opacity - analyzer reading

[3] Absolute value

Figure 1-1. Calibration Error Test

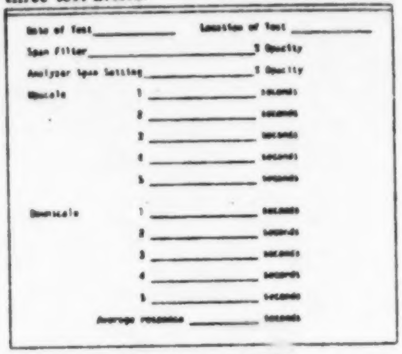


Figure 1-2. Response Time Test

9.2.5 Zero Drift. Using the zero opacity values measured every 24 hours during the field test (paragraph 8.2), calculate the differences between the zero point after cleaning, aligning, and adjustment, and the zero value 24 hours later just prior to cleaning, aligning, and adjustment. Calculate the mean value of these points and the confidence interval using equations 1-1 and 1-2. Report the sum of the absolute mean value and the 95 percent confidence interval.

9.2.6 Calibration Drift. Using the span value measured every 24 hours during the field test, calculate the differences between the span value after cleaning, aligning, and adjustment of zero and span, and the span value 24 hours later just after cleaning, aligning, and adjustment of zero and before adjustment of span. Calculate the mean value of these points and the confidence interval using equations 1-1 and 1-2. Report the sum of the absolute mean value and the confidence interval.

9.2.7 Response Time. Using the data from paragraph 8.1, calculate the time interval from filter insertion to 95 percent of the final stable value for all upscale and downscale traverses. Report the mean of the 10 upscale and downscale test times.

9.2.8 Operational Test Period. During the 168-hour operational test period, the continuous monitoring system shall not require any corrective maintenance, repair, replacement, or adjustment other than that clearly specified as required in the manufacturer's operation and maintenance manuals as routine and expected during a one-week period. If the continuous monitoring system is operated within the specified performance parameters and does not require corrective maintenance, repair, replacement, or adjustment other than as specified above during the 168-hour test period, the operational test period shall have been successfully concluded. Failure of the continuous monitoring system to meet these requirements shall call for a repetition of the 168-hour test period. Portions of the tests which were satisfactorily completed need not be repeated. Failure to meet any performance specification(s) shall call for a repetition of the one-week operational test period and that specific portion of the tests required by paragraph 8 related to demonstrating compliance with the failed specification. All maintenance and adjustments required shall be recorded. Output readings shall be recorded before and after all adjustments.

10. References.

10.1 "Experimental Statistics," Department of Commerce, National Bureau of Standards Handbook 91, 1963, pp. 3-31, paragraphs 3-3.1.4.

10.2 "Performance Specifications for Stationary-Source Monitoring Systems for Gases and Visible Emissions," Environmental Protection Agency, Research Triangle Park, N.C., EPA-650/2-74-013, January 1974.

Zero Setting ____________ (See paragraph 8.2.1) Date of Test ________________

Span Setting ____________

Date and Time	Zero Reading (Before cleaning and adjustment)	Zero Drift (ΔZero)	Span Reading (After cleaning and zero adjustment but before span adjustment)	Calibration Drift (ΔSpan)

Zero Drift = Mean Zero Drift* ____________ + CI (Zero) ____________ = ____________.

Calibration Drift = Mean Span Drift* ____________ + CI (Span) ____________ = ____________.

---

*Absolute value

PERFORMANCE SPECIFICATION 2—PERFORMANCE SPECIFICATIONS AND SPECIFICATION TEST PROCEDURES FOR MONITORS OF SO_2 AND NO_x FROM STATIONARY SOURCES

1. Principle and Applicability.

1.1 Principle. The concentration of sulfur dioxide or oxides of nitrogen pollutants in stack emissions is measured by a continuously operating emission measurement system. Concurrent with operation of the continuous monitoring system, the pollutant concentrations are also measured with reference methods (Appendix A). An average of the continuous monitoring system data is computed for each reference method testing period and compared to determine the relative accuracy of the continuous monitoring system. Other tests of the continuous monitoring system are also performed to determine calibration error, drift, and response characteristics of the system.

1.2 Applicability. This performance specification is applicable to evaluation of continuous monitoring systems for measurement of nitrogen oxides or sulfur dioxide pollutants. These specifications contain test procedures, installation requirements, and data computation procedures for evaluating the acceptability of the continuous monitoring systems.

2. Apparatus.

2.1 Calibration Gas Mixtures. Mixtures of known concentrations of pollutant gas in a diluent gas shall be prepared. The pollutant gas shall be sulfur dioxide or the appropriate oxide(s) of nitrogen specified by paragraph 6 and within subparts. For sulfur dioxide gas mixtures, the diluent gas may be air or nitrogen. For nitric oxide (NO) gas mixtures, the diluent gas shall be oxygen-free (<10 ppm) nitrogen, and for nitrogen dioxide (NO_2) gas mixtures the diluent gas shall be air. Concentrations of approximately 50 percent and 90 percent of span are required. The 90 percent gas mixture is used to set and to check the span and is referred to as the span gas.

2.2 Zero Gas. A gas certified by the manufacturer to contain less than 1 ppm of the pollutant gas or ambient air may be used.

2.3 Equipment for measurement of the pollutant gas concentration using the reference method specified in the applicable standard.

2.4 Data Recorder. Analog chart recorder or other suitable device with input voltage range compatible with analyzer system output. The resolution of the recorder's data output shall be sufficient to allow completion of the test procedures within this specification.

2.5 Continuous monitoring system for SO_2 or NO_x pollutants as applicable.

3. Definitions.

3.1 Continuous Monitoring System. The total equipment required for the determination of a pollutant gas concentration in a source effluent. Continuous monitoring systems consist of major subsystems as follows:

3.1.1 Sampling Interface—That portion of an extractive continuous monitoring system that performs one or more of the following operations: acquisition, transportation, and conditioning of a sample of the source effluent or that portion of an in-situ continuous monitoring system that protects the analyzer from the effluent.

3.1.2 Analyzer—That portion of the continuous monitoring system which senses the pollutant gas and generates a signal output that is a function of the pollutant concentration.

3.1.3 Data Recorder—That portion of the continuous monitoring system that provides a permanent record of the output signal in terms of concentration units.

3.2 Span. The value of pollutant concentration at which the continuous monitoring system is set to produce the maximum data display output. The span shall be set at the concentration specified in each applicable subpart.

3.3 Accuracy (Relative). The degree of correctness with which the continuous monitoring system yields the value of gas concentration of a sample relative to the value given by a defined reference method. This accuracy is expressed in terms of error, which is the difference between the paired concentration measurements expressed as a percentage of the mean reference value.

3.4 Calibration Error. The difference between the pollutant concentration indicated by the continuous monitoring system and the known concentration of the test gas mixture.

3.5 Zero Drift. The change in the continuous monitoring system output over a stated period of time of normal continuous operation when the pollutant concentration at the time for the measurements is zero.

3.6 Calibration Drift. The change in the continuous monitoring system output over a stated time period of normal continuous operations when the pollutant concentration at the time of the measurements is the same known upscale value.

3.7 Response Time. The time interval from a step change in pollutant concentration at the input to the continuous monitoring system to the time at which 95 percent of the corresponding final value is reached as displayed on the continuous monitoring system data recorder.

3.8 Operational Period. A minimum period of time over which a measurement system is expected to operate within certain performance specifications without unscheduled maintenance, repair, or adjustment.

3.9 Stratification. A condition identified by a difference in excess of 10 percent between the average concentration in the duct or stack and the concentration at any point more than 1.0 meter from the duct or stack wall.

4. Installation Specifications. Pollutant continuous monitoring systems (SO_2 and NO_x) shall be installed at a sampling location where measurements can be made which are directly representative (4.1), or which can be corrected so as to be representative (4.2) of the total emissions from the affected facility. Conformance with this requirement shall be accomplished as follows:

4.1 Effluent gases may be assumed to be nonstratified if a sampling location eight or more stack diameters (equivalent diameters) downstream of any air in-leakage is selected. This assumption and data correction procedures under paragraph 4.2.1 may not be applied to sampling locations upstream of an air preheater in a steam generating facility under Subpart D of this part. For sampling locations where effluent gases are either demonstrated (4.3) or may be assumed to be nonstratified (eight diameters), a point (extractive systems) or path (in-situ systems) of average concentration may be monitored.

4.2 For sampling locations where effluent gases cannot be assumed to be nonstratified (less than eight diameters) or have been shown under paragraph 4.3 to be stratified, results obtained must be consistently representative (e.g. a point of average concentration may shift with load changes) or the data generated by sampling at a point (extractive systems) or across a path (in-situ systems) must be corrected (4.2.1 and 4.2.2) so as to be representative of the total emissions from the affected facility. Conformance with this requirement may be accomplished in either of the following ways:

4.2.1 Installation of a diluent continuous monitoring system (O_2 or CO_2 as applicable) in accordance with the procedures under paragraph 4.2 of Performance Specification 3 of this appendix. If the pollutant and diluent monitoring systems are not of the same type (both extractive or both in-situ), the extractive system must use a multipoint probe.

4.2.2 Installation of extractive pollutant monitoring systems using multipoint sampling probes or in-situ pollutant monitoring systems that sample or view emissions which are consistently representative of the total emissions for the entire cross section. The Administrator may require data to be submitted to demonstrate that the emissions sampled or viewed are consistently representative for several typical facility process operating conditions.

4.3 The owner or operator may perform a traverse to characterize any stratification of effluent gases that might exist in a stack or duct. If no stratification is present, sampling procedures under paragraph 4.1 may be applied even though the eight diameter criteria is not met.

4.4 When single point sampling probes for extractive systems are installed within the stack or duct under paragraphs 4.1 and 4.2.1, the sample may not be extracted at any point less than 1.0 meter from the stack or duct wall. Multipoint sampling probes installed under paragraph 4.2.2 may be located at any points necessary to obtain consistently representative samples.

5. Continuous Monitoring System Performance Specifications.

The continuous monitoring system shall meet the performance specifications in Table 2-1 to be considered acceptable under this method.

TABLE 2-1.—*Performance specifications*

Parameter	*Specification*
1. Accuracy [1]	≤20 pct of the mean value of the reference method test data.
2. Calibration error [1]	≤ 5 pct of each (50 pct, 90 pct) calibration gas mixture value.
3. Zero drift (2 h) [1]	2 pct of span
4. Zero drift (24 h) [1]	Do.
5. Calibration drift (2 h) [1]	Do.
6. Calibration drift (24 h) [1]	2.5 pct. of span
7. Response time	15 min maximum.
8. Operational period	168 h minimum.

[1] Expressed as sum of absolute mean value plus 95 pct confidence interval of a series of tests.

6. Performance Specification Test Procedures. The following test procedures shall be used to determine conformance with the requirements of paragraph 5. For NO_x an-requirements of paragraph 5. For NO_x analyzers that oxidize nitric oxide (NO) to nitrogen dioxide (NO_2), the response time test under paragraph 6.3 of this method shall be performed using nitric oxide (NO) span gas. Other tests for NO_x continuous monitoring systems under paragraphs 6.1 and 6.2 and all tests for sulfur dioxide systems shall be performed using the pollutant span gas specified by each subpart.

6.1 Calibration Error Test Procedure. Set up and calibrate the complete continuous monitoring system according to the manufacturer's writen instructions. This may be accomplished either in the laboratory or in the field.

6.1.1 Calibration Gas Analyses. Triplicate analyses of the gas mixtures shall be performed within two weeks prior to use using Reference Methods 6 for SO_2 and 7 for NO_x. Analyze each calibration gas mixture (50%, 90%) and record the results on the example sheet shown in Figure 2-1. Each sample test result must be within 20 percent of the averaged result or the tests shall be repeated. This step may be omitted for non-extractive monitors where dynamic calibration gas mixtures are not used (6.1.2).

6.1.2 Calibration Error Test Procedure. Make a total of 15 nonconsecutive measurements by alternately using zero gas and each caliberation gas mixture concentration (e.g., 0%, 50%, 0%, 90%, 50%, 90%, 50%, 0%, etc.). For nonextractive continuous monitoring systems, this test procedure may be performed by using two or more calibration gas cells whose concentrations are certified by the manufacturer to be functionally equivalent to these gas concentrations. Convert the continuous monitoring system output readings to ppm and record the results on the example sheet shown in Figure 2-2.

6.2 Field Test for Accuracy (Relative), Zero Drift, and Calibration Drift. Install and operate the continuous monitoring system in accordance with the manufacturer's written instructions and drawings as follows:

6.2.1 Conditioning Period. Offset the zero setting at least 10 percent of the span so that negative zero drift can be quantified. Operate the system for an initial 168-hour conditioning period in normal operating manner.

6.2.2 Operational Test Period. Operate the continuous monitoring system for an additional 168-hour period retaining the zero offset. The system shall monitor the source effluent at all times except when being zeroed, calibrated, or backpurged.

6.2.2.1 Field Test for Accuracy (Relative). For continuous monitoring systems employing extractive sampling, the probe tip for the continuous monitoring system and the probe tip for the Reference Method sampling train should be placed at adjacent locations in the duct. For NO_x continuous monitoring systems, make 27 NO_x concentration measurements, divided into nine sets, using the applicable reference method. No more than one set of tests, consisting of three individual measurements, shall be performed in any one hour. All individual measurements of each set shall be performed concurrently, or within a three-minute interval and the results averaged. For SO_2 continuous monitoring systems, make nine SO_2 concentration measurements using the applicable reference method. No more than one measurement shall be performed in any one hour. Record the reference method test data and the continuous monitoring system concentrations on the example data sheet shown in Figure 2-3.

6.2.2.2 Field Test for Zero Drift and Calibration Drift. For extractive systems, determine the values given by zero and span gas pollutant concentrations at two-hour intervals until 15 sets of data are obtained. For nonextractive measurement systems, the zero value may be determined by mechanically producing a zero condition that provides a system check of the analyzer internal mirrors and all electronic circuitry including the radiation source and detector assembly or by inserting three or more calibration gas cells and computing the zero point from the upscale measurements. If this latter technique is used, a graph(s) must be retained by the owner or operator for each measurement system that shows the relationship between the upscale measurements and the zero point. The span of the system shall be checked by using a calibration gas cell certified by the manufacturer to be functionally equivalent to 50 percent of span concentration. Record the zero and span measurements (or the computed zero drift) on the example data sheet shown in Figure 2-4. The two-hour periods over which measurements are conducted need not be consecutive but may not overlap. All measurements required under this paragraph may be conducted concurrent with tests under paragraph 6.2.2.1.

6.2.2.3 Adjustments. Zero and calibration corrections and adjustments are allowed only at 24-hour intervals or at such shorter intervals as the manufacturer's written instructions specify. Automatic corrections made by the measurement system without operator intervention or initiation are allowable at any time. During the entire 168-hour operational test period, record on the example sheet shown in Figure 2-5 the values given by zero and span gas pollutant concentrations before and after adjustment at 24-hour intervals.

6.3 Field Test for Response Time.

6.3.1 Scope of Test. Use the entire continuous monitoring system as installed, including sample transport lines if used. Flow rates, line diameters, pumping rates, pressures (do not allow the pressurized calibration gas to change the normal operating pressure in the sample line), etc., shall be at the nominal values for normal operation as specified in the manufacturer's written instructions. If the analyzer is used to sample more than one pollutant source (stack), repeat this test for each sampling point.

6.3.2 Response Time Test Procedure. Introduce zero gas into the continuous monitoring system sampling interface or as close to the sampling interface as possible. When the system output reading has stabilized, switch quickly to a known concentration of pollutant gas. Record the time from concentration switching to 95 percent of final stable response. For non-extractive monitors, the highest available calibration gas concentration shall be switched into and out of the sample path and response times recorded. Perform this test sequence three (3) times. Record the results of each test on the example sheet shown in Figure 2-6.

7. Calculations, Data Analysis and Reporting.

7.1 Procedure for determination of mean values and confidence intervals.

7.1.1 The mean value of a data set is calculated according to equation 2-1.

$$\bar{x}=\frac{1}{n}\sum_{i=1}^{n} x_i \qquad \text{Equation 2-1}$$

where:

x_i = absolute value of the measurements,
Σ = sum of the individual values,
$\bar{x}$ = mean value, and
n = number of data points.

7.1.2 The 95 percent confidence interval (two-sided) is calculated according to equation 2-2:

$$C.I._{95}=\frac{t_{.975}}{n\sqrt{n-1}}\sqrt{n(\sum x_i^2)-(\sum x_i)^2} \qquad \text{Equation 2-2}$$

where:

$\sum x_i$ = sum of all data points,
$t_{.975} = t_1 - \alpha/2$, and
$C.I._{95}$ = 95 percent confidence interval estimate of the average mean value.

Values for $t_{.975}$

n	$t_{.975}$
2	12.706
3	4.303
4	3.182
5	2.776
6	2.571
7	2.447
8	2.365
9	2.306
10	2.262
11	2.228
12	2.201
13	2.179
14	2.160
15	2.145
16	2.131

The values in this table are already corrected for n-1 degrees of freedom. Use n equal to the number of samples as data points.

7.2 **Data Analysis and Reporting.**

7.2.1 Accuracy (Relative). For each of the nine reference method test points, determine the average pollutant concentration reported by the continuous monitoring system. These average concentrations shall be determined from the continuous monitoring system data recorded under 7.2.2 by integrating or averaging the pollutant concentrations over each of the time intervals concurrent with each reference method testing period. Before proceeding to the next step, determine the basis (wet or dry) of the continuous monitoring system data and reference method test data concentrations. If the bases are not consistent, apply a moisture correction to either reference method concentrations or the continuous monitoring system concentrations as appropriate. Determine the correction factor by moisture tests concurrent with the reference method testing periods. Report the moisture test method and the correction procedure employed. For each of the nine test runs determine the difference for each test run by subtracting the respective reference method test concentrations (use average of each set of three measurements for NO_x) from the continuous monitoring system integrated or averaged concentrations. Using these data, compute the mean difference and the 95 percent confidence interval of the differences (equations 2-1 and 2-2). Accuracy is reported as the sum of the absolute value of the mean difference and the 95 percent confidence interval of the differences expressed as a percentage of the mean reference method value. Use the example sheet shown in Figure 2-3.

7.2.2 Calibration Error. Using the data from paragraph 6.1, subtract the measured pollutant concentration determined under paragraph 6.1.1 (Figure 2-1) from the value shown by the continuous monitoring system for each of the five readings at each concentration measured under 6.1.2 (Figure 2-2). Calculate the mean of these difference values and the 95 percent confidence intervals according to equations 2-1 and 2-2. Report the calibration error (the sum of the absolute value of the mean difference and the 95 percent confidence interval) as a percentage of each respective calibration gas concentration. Use example sheet shown in Figure 2-2.

7.2.3 Zero Drift (2-hour). Using the zero concentration values measured each two hours during the field test, calculate the differences between consecutive two-hour readings expressed in ppm. Calculate the mean difference and the confidence interval using equations 2-1 and 2-2. Report the zero drift as the sum of the absolute mean value and the confidence interval as a percentage of span. Use example sheet shown in Figure 2-4.

7.2.4 Zero Drift (24-hour). Using the zero concentration values measured every 24 hours during the field test, calculate the differences between the zero point after zero adjustment and the zero value 24 hours later just prior to zero adjustment. Calculate the mean value of these points and the confidence interval using equations 2-1 and 2-2. Report the zero drift (the sum of the absolute mean and confidence interval) as a percentage of span. Use example sheet shown in Figure 2-5.

7.2.5 Calibration Drift (2-hour). Using the calibration values obtained at two-hour intervals during the field test, calculate the differences between consecutive two-hour readings expressed as ppm. These values should be corrected for the corresponding zero drift during that two-hour period. Calculate the mean and confidence interval of these corrected difference values using equations 2-1 and 2-2. Do not use the differences between non-consecutive readings. Report the calibration drift as the sum of the absolute mean and confidence interval as a percentage of span. Use the example sheet shown in Figure 2-4.

7.2.6 Calibration Drift (24-hour). Using the calibration values measured every 24 hours during the field test, calculate the differences between the calibration concentration reading after zero and calibration adjustment, and the calibration concentration reading 24 hours later after zero adjustment but before calibration adjustment. Calculate the mean value of these differences and the confidence interval using equations 2-1 and 2-2. Report the calibration drift (the sum of the absolute mean and confidence interval) as a percentage of span. Use the example sheet shown in Figure 2-5.

7.2.7 Response Time. Using the charts from paragraph 6.3, calculate the time interval from concentration switching to 95 percent to the final stable value for all upscale and downscale tests. Report the mean of the three upscale test times and the mean of the three downscale test times. The two average times should not differ by more than 15 percent of the slower time. Report the slower time as the system response time. Use the example sheet shown in Figure 2-6.

7.2.8 Operational Test Period. During the 168-hour performance and operational test period, the continuous monitoring system shall not require any corrective maintenance, repair, replacement, or adjustment other than that clearly specified as required in the operation and maintenance manuals as routine and expected during a one-week period. If the continuous monitoring system operates within the specified performance parameters and does not require corrective maintenance, repair, replacement or adjustment other than as specified above during the 168-hour test period, the operational period will be successfully concluded. Failure of the continuous monitoring system to meet this requirement shall call for a repetition of the 168-hour test period. Portions of the test which were satisfactorily completed need not be repeated. Failure to meet any performance specifications shall call for a repetition of the one-week performance test period and that portion of the testing which is related to the failed specification. All maintenance and adjustments required shall be recorded. Output readings shall be recorded before and after all adjustments.

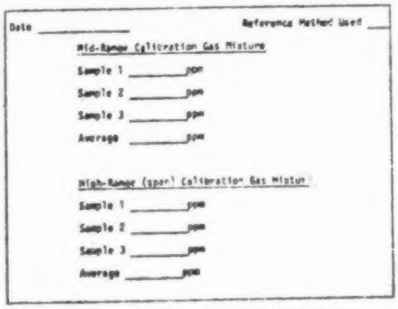
8. References.

8.1 "Monitoring Instrumentation for the Measurement of Sulfur Dioxide in Stationary Source Emissions," Environmental Protection Agency, Research Triangle Park, N.C., February 1973.

8.2 "Instrumentation for the Determination of Nitrogen Oxides Content of Stationary Source Emissions," Environmental Protection Agency, Research Triangle Park, N.C., Volume 1, APTD-0847, October 1971; Volume 2, APTD-0942, January 1972.

8.3 "Experimental Statistics," Department of Commerce, Handbook 91, 1963, pp. 3-31, paragraphs 3-3.1.4.

8.4 "Performance Specifications for Stationary-Source Monitoring Systems for Gases and Visible Emissions," Environmental Protection Agency, Research Triangle Park, N.C., EPA-650/2-74-013, January 1974.



Date ________ Reference Method Used ____

Mid-Range Calibration Gas Mixture

Sample 1 ________ppm

Sample 2 ________ppm

Sample 3 ________ppm

Average ________ppm

High-Range (span) Calibration Gas Mixture

Sample 1 ________ppm

Sample 2 ________ppm

Sample 3 ________ppm

Average ________ppm

Figure 2-1. Analysis of Calibration Gas Mixtures

Calibration Gas Mixture Data (From Figure 2-1)

Mid (50%) _____ppm   High (90%) _____ppm

Run #	Calibration Gas Concentration, ppm	Measurement System Reading, ppm	Differences,[1] ppm
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

	Mid	High
Mean difference	____	____
Confidence interval	± ____	± ____
Calibration error = $\frac{\text{Mean Difference}^{2} + \text{C.I.}}{\text{Average Calibration Gas Concentration}} \times 100$	____%	____%

---

[1] Calibration gas concentration - measurement system reading

[2] Absolute value

Figure 2-2. Calibration Error Determination

Test No.	Date and Time	Reference Method Samples					Analyzer 1-Hour Average (ppm)*		Difference (ppm)	
		SO_2 Sample 1 (ppm)	NO_x Sample 1 (ppm)	NO_x Sample 2 (ppm)	NO_x Sample 3 (ppm)	NO_x Sample Average (ppm)	SO_2	NO_x	SO_2	NO_x
1										
2										
3										
4										
5										
6										
7										
8										
9										

Mean reference method test value (SO_2) ____

Mean reference method test value (NO_x) ____

Mean of the differences ____

95% Confidence intervals = ± ____ ppm (SO_2) = ± ____ ppm (NO_x)

Accuracies = $\frac{\text{Mean of the differences} + \text{95\% confidence interval}}{\text{Mean reference method value}} \times 100$ = ____% (SO_2) = ____% (NO_x)

* Explain and report method used to determine integrated averages

Figure 2-3. Accuracy Determination (SO_2 and NO_x)

Data Set No.	Time		Date	Zero Reading	Zero Drift (ΔZero)	Span Reading	Span Drift (ΔSpan)	Calibration Drift (Span- Zero)
	Begin	End						
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

Zero Drift = [Mean Zero Drift* ________ + CI (Zero) ________] ÷ [Span] x 100 = ________.
Calibration Drift = [Mean Span Drift* ______ + CI (Span) ________] ÷ [Span] x 100 = ________.
*Absolute Value.

Figure 2-4. Zero and Calibration Drift (2 hour)

Date and Time	Zero Reading	Zero Drift (ΔZero)	Span Reading (After zero adjustment)	Calibration Drift (ΔSpan)

Zero Drift = [Mean Zero Drift* _______ + C.I. (Zero) _______]
÷ [Instrument Span] x 100 = _________.

Calibration Drift = [Mean Span Drift* _________ + C.I. (Span) _________]
÷ [Instrument Span] x 100 = _________.

* Absolute value

Figure 2-5. Zero and Calibration Drift (24-hour)

Reproduced from best available copy.

Date of Test ____________

Span Gas Concentration ________ ppm

Analyzer Span Setting ________ ppm

Upscale
1 ________ seconds
2 ________ seconds
3 ________ seconds

Average upscale response ________ seconds

Downscale
1 ________ seconds
2 ________ seconds
3 ________ seconds

Average downscale response ________ seconds

System average response time (slower time) = ________ seconds.

$$\%\text{deviation from slower system average response} = \left[\frac{\text{average upscale minus average downscale}}{\text{slower time}}\right] \times 100\% = \_\_\_\_\_.$$

Figure 2-6. Response Time

Performance Specification 3—Performance specifications and specification test procedures for monitors of CO_2 and O_2 from stationary sources.

1. Principle and Applicability.

1.1 Principle. Effluent gases are continuously sampled and are analyzed for carbon dioxide or oxygen by a continuous monitoring system. Tests of the system are performed during a minimum operating period to determine zero drift, calibration drift, and response time characteristics.

1.2 Applicability. This performance specification is applicable to evaluation of continuous monitoring systems for measurement of carbon dioxide or oxygen. These specifications contain test procedures, installation requirements, and data computation procedures for evaluating the acceptability of the continuous monitoring systems subject to approval by the Administrator. Sampling may include either extractive or non-extractive (in-situ) procedures.

2. Apparatus.

2.1 Continuous Monitoring System for Carbon Dioxide or Oxygen.

2.2 Calibration Gas Mixtures. Mixture of known concentrations of carbon dioxide or oxygen in nitrogen or air. Midrange and 90 percent of span carbon dioxide or oxygen concentrations are required. The 90 percent of span gas mixture is to be used to set and check the analyzer span and is referred to as span gas. For oxygen analyzers, if the span is higher than 21 percent O_2, ambient air may be used in place of the 90 percent of span calibration gas mixture. Triplicate analyses of the gas mixture (except ambient air) shall be performed within two weeks prior to use using Reference Method 3 of this part.

2.3 Zero Gas. A gas containing less than 100 ppm of carbon dioxide or oxygen.

2.4 Data Recorder. Analog chart recorder or other suitable device with input voltage range compatible with analyzer system output. The resolution of the recorder's data output shall be sufficient to allow completion of the test procedures within this specification.

3. Definitions.

3.1 Continuous Monitoring System. The total equipment required for the determination of carbon dioxide or oxygen in a given source effluent. The system consists of three major subsystems:

3.1.1 Sampling Interface. That portion of the continuous monitoring system that performs one or more of the following operations: delineation, acquisition, transportation, and conditioning of a sample of the source effluent or protection of the analyzer from the hostile aspects of the sample or source environment.

3.1.2 Analyzer. That portion of the continuous monitoring system which senses the pollutant gas and generates a signal output that is a function of the pollutant concentration.

3.1.3 Data Recorder. That portion of the continuous monitoring system that provides a permanent record of the output signal in terms of concentration units.

3.2 Span. The value of oxygen or carbon dioxide concentration at which the continuous monitoring system is set that produces the maximum data display output. For the purposes of this method, the span shall be set no less than 1.5 to 2.5 times the normal carbon dioxide or normal oxygen concentration in the stack gas of the affected facility.

3.3 Midrange. The value of oxygen or carbon dioxide concentration that is representative of the normal conditions in the stack gas of the affected facility at typical operating rates.

3.4 Zero Drift. The change in the continuous monitoring system output over a stated period of time of normal continuous operation when the carbon dioxide or oxygen concentration at the time for the measurements is zero.

3.5 Calibration Drift. The change in the continuous monitoring system output over a stated time period of normal continuous operation when the carbon dioxide or oxygen continuous monitoring system is measuring the concentration of span gas.

3.6 Operational Test Period. A minimum period of time over which the continuous monitoring system is expected to operate within certain performance specifications without unscheduled maintenance, repair, or adjustment.

3.7 Response time. The time interval from a step change in concentration at the input to the continuous monitoring system to the time at which 95 percent of the corresponding final value is displayed on the continuous monitoring system data recorder.

4. Installation Specification.

Oxygen or carbon dioxide continuous monitoring systems shall be installed at a location where measurements are directly representative of the total effluent from the affected facility or representative of the same effluent sampled by a SO_2 or NO_x continuous monitoring system. This requirement shall be complied with by use of applicable requirements in Performance Specification 2 of this appendix as follows:

4.1 Installation of Oxygen or Carbon Dioxide Continuous Monitoring Systems Not Used to Convert Pollutant Data. A sampling location shall be selected in accordance with the procedures under paragraphs 4.2.1 or 4.2.2, or Performance Specification 2 of this appendix.

4.2 Installation of Oxygen or Carbon Dioxide Continuous Monitoring Systems Used to Convert Pollutant Continuous Monitoring System Data to Units of Applicable Standards. The diluent continuous monitoring system (oxygen or carbon dioxide) shall be installed at a sampling location where measurements that can be made are representative of the effluent gases sampled by the pollutant continuous monitoring system(s). Conformance with this requirement may be accomplished in any of the following ways:

4.2.1 The sampling location for the diluent system shall be near the sampling location for the pollutant continuous monitoring system such that the same approximate point(s) (extractive systems) or path (in-situ systems) in the cross section is sampled or viewed.

4.2.2 The diluent and pollutant continuous monitoring systems may be installed at different locations if the effluent gases at both sampling locations are nonstratified as determined under paragraphs 4.1 or 4.3, Performance Specification 2 of this appendix and there is no in-leakage occurring between the two sampling locations. If the effluent gases are stratified at either location, the procedures under paragraph 4.2.2, Performance Specification 2 of this appendix shall be used for installing continuous monitoring systems at that location.

5. Continuous Monitoring System Performance Specifications.

The continuous monitoring system shall meet the performance specifications in Table 3–1 to be considered acceptable under this method.

6. Performance Specification Test Procedures.

The following test procedures shall be used to determine conformance with the requirements of paragraph 4. Due to the wide variation existing in analyzer designs and principles of operation, these procedures are not applicable to all analyzers. Where this occurs, alternative procedures, subject to the approval of the Administrator, may be employed. Any such alternative procedures must fulfill the same purposes (verify response, drift, and accuracy) as the following procedures, and must clearly demonstrate conformance with specifications in Table 3–1.

6.1 Calibration Check. Establish a calibration curve for the continuous monitoring system using zero, midrange, and span concentration gas mixtures. Verify that the resultant curve of analyzer reading compared with the calibration gas value is consistent with the expected response curve as described by the analyzer manufacturer. If the expected response curve is not produced, additional calibration gas measurements shall be made, or additional steps undertaken to verify the accuracy of the response curve of the analyzer.

6.2 Field Test for Zero Drift and Calibration Drift. Install and operate the continuous monitoring system in accordance with the manufacturer's written instructions and drawings as follows:

TABLE 3-1.—*Performance specifications*

Parameter	*Specification*
1. Zero drift (2 h) [1]	≤0.4 pct O_2 or CO_2.
2. Zero drift (24 h) [1]	≤0.5 pct O_2 or CO_2.
3. Calibration drift (2 h) [1]	≤0.4 pct O_2 or CO_2.
4. Calibration drift (24 h) [1]	≤0.5 pct O_2 or CO_2.
5. Operational period	168 h minimum.
6. Response time	10 min.

[1] Expressed as sum of absolute mean value plus 95 pct confidence interval of a series of tests.

6.2.1 Conditioning Period. Offset the zero setting at least 10 percent of span so that negative zero drift may be quantified. Operate the continuous monitoring system for an initial 168-hour conditioning period in a normal operational manner.

6.2.2. Operational Test Period. Operate the continuous monitoring system for an additional 168-hour period maintaining the zero offset. The system shall monitor the source effluent at all times except when being zeroed, calibrated, or backpurged.

6.2.3 Field Test for Zero Drift and Calibration Drift. Determine the values given by zero and midrange gas concentrations at two-hour intervals until 15 sets of data are obtained. For non-extractive continuous monitoring systems, determine the zero value given by a mechanically produced zero condition or by computing the zero value from upscale measurements using calibrated gas cells certified by the manufacturer. The midrange checks shall be performed by using certified calibration gas cells functionally equivalent to less than 50 percent of span. Record these readings on the example sheet shown in Figure 3-1. These two-hour periods need not be consecutive but may not overlap. In-situ CO_2 or O_2 analyzers which cannot be fitted with a calibration gas cell may be calibrated by alternative procedures acceptable to the Administrator. Zero and calibration corrections and adjustments are allowed only at 24-hour intervals or at such shorter intervals as the manufacturer's written instructions specify. Automatic corrections made by the continuous monitoring system without operator intervention or initiation are allowable at any time. During the entire 168-hour test period, record the values given by zero and span gas concentrations before and after adjustment at 24-hour intervals in the example sheet shown in Figure 3-2.

6.3 Field Test for Response Time.

6.3.1 Scope of Test.

This test shall be accomplished using the continuous monitoring system as installed, including sample transport lines if used. Flow rates, line diameters, pumping rates, pressures (do not allow the pressurized calibration gas to change the normal operating pressure in the sample line), etc., shall be at the nominal values for normal operation as specified in the manufacturer's written instructions. If the analyzer is used to sample more than one source (stack), this test shall be repeated for each sampling point.

6.3.2 Response Time Test Procedure.

Introduce zero gas into the continuous monitoring system sampling interface or as close to the sampling interface as possible. When the system output reading has stabilized, switch quickly to a known concentration of gas at 90 percent of span. Record the time from concentration switching to 95 percent of final stable response. After the system response has stabilized at the upper level, switch quickly to a zero gas. Record the time from concentration switching to 95 percent of final stable response. Alternatively, for nonextractive continuous monitoring systems, the highest available calibration gas concentration shall be switched into and out of the sample path and response times recorded. Perform this test sequence three (3) times. For each test, record the results on the data sheet shown in Figure 3-3.

7. Calculations, Data Analysis, and Reporting.

7.1 Procedure for determination of mean values and confidence intervals.

7.1.1 The mean value of a data set is calculated according to equation 3-1.

$$\bar{x}=\frac{1}{n}\sum_{i=1}^{n} x_i \qquad \text{Equation 3-1}$$

where:

x_i = absolute value of the measurements,
Σ = sum of the individual values,
x = mean value, and
n = number of data points.

7.2.1 The 95 percent confidence interval (two-sided) is calculated according to equation 3-2:

$$C.I._{95}=\frac{t_{.975}}{n\sqrt{n-1}}\sqrt{n(\sum x_i^2)-(\sum x_i)^2} \qquad \text{Equation 3-2}$$

where:

ΣX = sum of all data points,
$t_{.975} = t_1 - \alpha/2$, and
$C.I._{95}$ = 95 percent confidence interval estimates of the average mean value

Values for $t_{.975}$

n	$t_{.975}$
	12.706
3	4.303
4	3.182
5	2.776
6	2.571
7	2.447
8	2.365
9	2.306
10	2.262
11	2.228
12	2.201
13	2.179
14	2.160
15	2.145
16	2.131

The values in this table are already corrected for n-1 degrees of freedom. Use n equal to the number of samples as data points.

7.2 Data Analysis and Reporting.

7.2.1 Zero Drift (2-hour). Using the zero concentration values measured each two hours during the field test, calculate the differences between the consecutive two-hour readings expressed in ppm. Calculate the mean difference and the confidence interval using equations 3-1 and 3-2. Record the sum of the absolute mean value and the confidence interval on the data sheet shown in Figure 3-1.

7.2.2 Zero Drift (24-hour). Using the zero concentration values measured every 24 hours during the field test, calculate the differences between the zero point after zero adjustment and the zero value 24 hours later just prior to zero adjustment. Calculate the mean value of these points and the confidence interval using equations 3-1 and 3-2. Record the zero drift (the sum of the absolute mean and confidence interval) on the data sheet shown in Figure 3-2.

7.2.3 Calibration Drift (2-hour). Using the calibration values obtained at two-hour intervals during the field test, calculate the differences between consecutive two-hour readings expressed as ppm. These values should be corrected for the corresponding zero drift during that two-hour period. Calculate the mean and confidence interval of these corrected difference values using equations 3-1 and 3-2. Do not use the differences between non-consecutive readings. Record the sum of the absolute mean and confidence interval upon the data sheet shown in Figure 3-1.

7.2.4 Calibration Drift (24-hour). Using the calibration values measured every 24 hours during the field test, calculate the differences between the calibration concentration reading after zero and calibration adjustment and the calibration concentration reading 24 hours later after zero adjustment but before calibration adjustment. Calculate the mean value of these differences and the confidence interval using equations 3-1 and 3-2. Record the sum of the absolute mean and confidence interval on the data sheet shown in Figure 3-2.

7.2.5 Operational Test Period. During the 168-hour performance and operational test period, the continuous monitoring system shall not receive any corrective maintenance, repair, replacement, or adjustment other than that clearly specified as required in the manufacturer's written operation and maintenance manuals as routine and expected during a one-week period. If the continuous monitoring system operates within the specified performance parameters and does not require corrective maintenance, repair, replacement or adjustment other than as specified above during the 168-hour test period, the operational period will be successfully concluded. Failure of the continuous monitoring system to meet this requirement shall call for a repetition of the 168 hour test period. Portions of the test which were satisfactorily completed need not be repeated. Failure to meet any performance specifications shall call for a repetition of the one-week performance test period and that portion of the testing which is related to the failed specification. All maintenance and adjustments required shall be recorded. Output readings shall be recorded before and after all adjustments.

7.2.6 Response Time. Using the data developed under paragraph 6.3, calculate the time interval from concentration switching to 95 percent to the final stable value for all upscale and downscale tests. Report the mean of the three upscale test times and the mean of the three downscale test times. The two average times should not differ by more than 15 percent of the slower time. Report the slower time as the system response time. Record the results on Figure 3-3.

8. References.

8.1 "Performance Specifications for Stationary Source Monitoring Systems for Gases and Visible Emissions," Environmental Protection Agency, Research Triangle Park, N.C., EPA-650/2-74-013, January 1974.

8.2 "Experimental Statistics," Department of Commerce, National Bureau of Standards Handbook 91, 1963, pp. 3-31, paragraphs 3-3.1.4.

(Secs. 111 and 114 of the Clean Air Act, as amended by sec. 4(a) of Pub. L. 91-604, 84 Stat. 1678 (42 U.S.C. 1857c-6, by sec. 15(c)(2) of Pub. L. 91-604, 85 Stat. 1713 (42 U.S.C. 1857g)).

Data Set No.	Time		Date	Zero Reading	Zero Drift (ΔZero)	Span Reading	Span Drift (ΔSpan)	Calibration Drift (ΔSpan-ΔZero)
	Begin	End						
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

Zero Drift = [Mean Zero Drift* ________ + CI (Zero ________] = ________.
Calibration Drift = [Mean Span Drift* ______ + CI (Span ______] = ________.
*Absolute Value.

Figure 3-1. Zero and Calibration Drift (2 Hour).

Date and Time	Zero Reading	Zero Drift (ΔZero)	Span Reading (After zero adjustment)	Calibration Drift (ΔSpan)

Zero Drift = [Mean Zero Drift* ________ + C.I. (Zero) ________]
= ________.

Calibration Drift = [Mean Span Drift* ________ + C.I. (Span) ________]
= ________.

* Absolute value

Figure 3-2. Zero and Calibration Drift (24-hour)

Date of Test ____________

Span Gas Concentration _________ ppm

Analyzer Span Setting _________ ppm

Upscale
1. _________ seconds
2. _________ seconds
3. _________ seconds

Average upscale response _________ seconds

Downscale
1. _________ seconds
2. _________ seconds
3. _________ seconds

Average downscale response _________ seconds

System average response time (slower time) = _________ seconds

% deviation from slower system average response = $\dfrac{\text{average upscale minus average downscale}}{\text{slower time}} \times 100\%$

= ____________.

Figure 3-3. Response

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c-9).).

Title 40—Protection of Environment

CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY

SUBCHAPTER C—AIR PROGRAMS

PART 60—STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

Additions and Miscellaneous Amendments

* * * * *

OPACITY

It is evident from comments received that an inadequate explanation was given for applying both an enforceable opacity standard and an enforceable concentration standard to the same source and that the relationship between the concentration standard and the opacity standard was not clearly presented. Because all but one of the regulations include these dual standards, this subject is dealt with here from the general viewpoint. Specific changes made to the regulations proposed for a specific source are described in the discussions of each source.

A discussion of the major points raised by the comments on the opacity standard follows:

1. Several commentators felt that opacity limits should be only guidelines for determining when to conduct the stack tests needed to determine compliance with concentration/mass standards. Several other commentators expressed the opinion that the opacity standard was more stringent than the concentration/mass standard.

As promulgated below, the opacity standards are regulatory requirements, just like the concentration/mass standards. It is not necessary to show that the concentration/mass standard is being violated in order to support enforcement of the opacity standard. Where opacity and concentration/mass standards are applicable to the same source, the opacity standard is not more restrictive than the concentration/mass standard. The concentration/mass standard is established at a level which will result in the design, installation, and operation of the best adequately demonstrated system of emission reduction (taking costs into account) for each source. The opacity standard is established at a level which will require proper operation and maintenance of such control systems on a day-to-day basis, but not require the design and installation of a control system more efficient or expensive than that required by the concentration/mass standard.

Opacity standards are a necessary supplement to concentration/mass standards. Opacity standards help ensure that sources and emission control systems continue to be properly maintained and operated so as to comply with concentration/mass standards. Particulate testing by EPA method 5 and most other techniques requires an expenditure of $3,000 to $10,000 per test including about 300 man-hours of technical and semitechnical personnel. Furthermore, scheduling and preparation are required such that it is seldom possible to conduct a test with less than 2 weeks notice. Therefore, method 5 particulate tests can be conducted only on an infrequent basis.

If there were no standards other than concentration/mass standards, it would be possible to inadequately operate or maintain pollution control equipment at all times except during periods of performance testing. It takes 2 weeks or longer to schedule a typical stack test. If only small repairs were required, e.g., pump or fan repair or replacement of fabric filter bags, such remedial action could be delayed until shortly before the test is conducted. For some types of equipment such as scrubbers, the energy input could be reduced (the pressure drop through the system) when stack tests weren't being conducted, which would result in the release of significantly more particulate matter than normal. Therefore, EPA has required that operators properly maintain air pollution control equipment at all times (40 CFR 60.11(d)) and meet opacity standards at all times except during periods of startup, shutdown, and malfunction (40 CFR 60.11(c)), and during other periods of exemption as specified in individual regulations.

Opacity of emissions is indicative of whether control equipment is properly maintained and operated. However, it is established as an independent enforceable standard, rather than an indicator of maintenance and operating conditions because information concerning the latter is peculiarly within the control of the plant operator. Furthermore, the time and expense required to prove that proper procedures have not been followed are so great that the provisions of 40 CFR 60.11(d) by themselves (without opacity standards) would not provide an economically sensible means of ensuring on a day-to-day basis that emissions of pollutants are within allowable limits. Opacity standards require nothing more than a trained observer and can be performed with no prior notice. Normally, it is not even necessary for the observer to be admitted to the plant to determine properly the opacity of stack emissions. Where observed opacities are within allowable limits, it is not normally necessary for enforcement personnel to enter the plant or contact plant personnel. However, in some cases, including times when opacity standards may not be violated, a full investigation of operating and maintenance conditions will be desirable. Accordingly, EPA has requirements for both opacity limits and proper operating and maintenance procedures.

2. Some commentators suggested that the regulatory opacity limits should be lowered to be consistent with the opacity observed at existing plants; others felt that the opacity limits were too stringent. The regulatory opacity limits are sufficiently close to observed opacity to ensure proper operation and maintenance of control systems on a continuing basis but still allow some room for minor variations from the conditions existing at the time opacity readings were made.

3. There are specified periods during which opacity standards do not apply. Commentators questioned the rationale for these time exemptions, as proposed, some pointing out that the exemptions were not justified and some that they were inadequate. Time exemptions further reflect the stated purpose of opacity standards by providing relief from such standards during periods when acceptable systems of emission reduction are judged to be incapable of meeting prescribed opacity limits. Opacity standards do not apply to emissions during periods of startup, shutdown, and malfunction (see Federal Register of October 15, 1973, 38 FR 28564), nor do opacity standards apply during periods judged necessary to permit the observed excess emissions caused by soot-blowing and unstable process conditions. Some confusion resulted from the fact that the startup-shutdown-malfunction regulations were proposed separately (see Federal Register of May 2, 1973, 38 FR 10820) from the regultions for this group of new sources. Although this was pointed out in the preamble (see Federal Register of June 11, 1973, 38 FR 15406) to this group of new source performance standards, it appears to have escaped the notice of several commentators.

4. Other comments, along with restudy of sources and additional opacity observations, have led to definition of specific time exemptions, where needed, to account for excess emissions resulting from soot-blowing and process variations. These specific actions replace the generalized approach to time exemptions, 2 minutes per hour, contained in all but one of the proposed opacity standards. The intent of the 2 minutes was to prevent the opacity standards from being unfairly stringent and reflected an arbitrary selection of a time exemption to serve this purpose. Comments noted that observed opacity and operating conditions did not support this approach. Some pointed out that these exemptions were not warranted; others, that they were inadequate. The cyclical basic oxygen steel-making process, for example, does not operate in hourly cycles and the inappropriateness of 2 minutes per hour in this case would apply to other cyclical processes which exist both in sources now subject to standards of performance and sources for which standards will be developed in the future. The time exemptions now provide for circumstances specific to the sources and, coupled with the startup-shutdown-malfunction provisions and the higher-than-observed opacity limits, provide much better assurance that the opacity standards are not unfairly stringent.

* * * * *

Dated: February 22, 1974.

RUSSELL E. TRAIN,
Administrator.

FEDERAL REGISTER, VOL. 39, NO. 47—FRIDAY, MARCH 8, 1974

Title 40—Protection of the Environment

CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY

SUBCHAPTER C—AIR PROGRAMS

[FRL 291-6]

PART 60—STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

Opacity Provisions

On June 29, 1973, the United States Court of Appeals for the District of Columbia in "Portland Cement Association v. Ruckelshaus," 486 F. 2d 375 (1973) remanded to EPA the standard of performance for Portland cement plants (40 CFR 60.60 et seq.) promulgated by EPA under section 111 of the Clean Air Act. In the remand, the Court directed EPA to reconsider among other things the use of the opacity standards. EPA has prepared a response to the remand. Copies of this response are available from the Emission Standards and Engineering Division, Environmental Protection Agency, Research Triangle Park, N.C. 27711, Attn: Mr. Don R. Goodwin. In developing the response, EPA collected and evaluated a substantial amount of information which is summarized and referenced in the response. Copies of this information are available for inspection during normal office hours at EPA's Office of Public Affairs, 401 M Street SW., Washington, D.C. EPA determined that the Portland cement plant standards generally did not require revision but did not find that certain revisions are appropriate to the opacity provisions of the standards. The provisions promulgated herein include a revision to § 60.11, Compliance with Standards and Maintenance Requirements, a revision to the opacity standard for Portland cement plants, and revisions to Reference Method 9. The bases for the revisions are discussed in detail in the Agency's response to the remand. They are summarized below.

The revisions to § 60.11 include the modification of paragraph (b) and the addition of paragraph (e). Paragraph (b) has been revised to indicate that while Reference Method 9 remains the primary and accepted means for determining compliance with opacity standards in this part, EPA will accept as probative evidence in certain situations and under certain conditions the results of continuous monitoring by transmissometer to determine whether a violation has in fact occurred. The revision makes clear that even in such situations the results of opacity readings by Method 9 remain presumptively valid and correct.

The provisions in paragraph (e) provide a mechanism for an owner or operator to petition the Administrator to establish an opacity standard for an affected facility where such facility meets all applicable standards for which a performance test is conducted under § 60.8 but fails to meet an applicable opacity standard. This provision is intended primarily to apply to cases where a source installs a very large diameter stack which causes the opacity of the emissions to be greater than if a stack of the diameter ordinarily used in the industry were installed. Although this situation is considered to be very unlikely to occur, this provision will accommodate such a situation. The provision could also apply to other situations where for any reason an affected facility could fail to meet opacity standards while meeting mass emission standards, although no such situations are expected to occur.

A revision to the opacity standard for Portland cement plants is promulgated herein. The revision changes the opacity limit for kilns from 10 percent to 20 percent. This revision is based on EPA's policy on opacity standards and the new emission data from Portland cement plants evaluated by EPA during its reconsideration. The preamble to the standards of performance which were promulgated on March 8, 1974 (39 FR 9308) sets forth EPA's policy on opacity standards: (1) Opacity limits are independent enforceable standards; (2) where opacity and mass/concentration standards are applicable to the same source, the mass/concentration standards are established at a level which will result in the design, installation, and operation of the best adequately demonstrated system of emission reduction (taking costs into account); and (3) the opacity standards are established at a level which will require proper operation and maintenance of such control systems. The new data indicate that increasing the opacity limits for kilns from 10 percent to 20 percent is justified, because such a standard will still require the design, installation, and operation of the best adequately demonstrated system of emission reduction (taking costs into account) while eliminating or minimizing the situations where it will be necessary to promulgate a new opacity standard under § 60.11(e).

In evaluating the accuracy of results from qualified observers following the procedures of Reference Method 9, EPA determined that some revisions to Reference Method 9 are consistently able to evaluation showed that observers trained and certified in accordance with the procedures prescribed under Reference Method 9 are consistently able to read opacity with errors not exceeding + 7.5 percent based upon single sets of the average of 24 readings. The revisions to Reference Method 9 include the following:

1. An introductory section is added. This includes a discussion of the concept of visible emission reading and describes the effect of variable viewing conditions. Information is also presented concerning the accuracy of the method noting that the accuracy of the method must be taken into account when determining possible violations of applicable opacity standards.

2. Provisions are added which specify that the determination of opacity requires averaging 24 readings taken at 15-second intervals. The purpose for taking 24 readings is both to extend the averaging time over which the observations are made, and to take sufficient readings to insure acceptable accuracy.

3. More specific criteria concerning observer position with respect to the sun are added. Specifically, the sun must be within a 140° sector to the observer's back.

4. Criteria concerning an observer's position with respect to the plume are added. Specific guidance is also provided for reading emissions from rectangular emission points with large length to width ratios, and for reading emissions from multiple stacks. In each of these cases, emissions are to be read across the shortest path length.

5. Provisions are added to make clear that opacity of contaminated water or steam plumes is to be read at a point where water does not exist in condensed form. Two specific instructions are provided: One for the case where opacity can be observed prior to the formation of the condensed water plume, and one for the case where opacity is to be observed after the condensed water plume has dissipated.

6. Specifications are added for the smoke generator used for qualification of observers so that State or local air pollution control agencies may provide observer qualification training consistent with EPA training.

In developing this regulation we have taken into account the comments received in response to the September 11, 1974 (39 FR 35852) notice of proposed rulemaking which proposed among other things certain minor changes to Reference Method 9. This regulation represents the rulemaking with respect to the revisions to Method 9.

The determination of compliance with applicable opacity standards will be based on an average of 24 consecutive opacity readings taken at 15 second intervals. This approach is a satisfactory means of enforcing opacity standards in cases where the violation is a continuing one and time exceptions are not part of the applicable opacity standard. However, the opacity standards for steam electric generators in 40 CFR 60.42 and fluid catalytic cracking unit catalyst regenerators in 40 CFR 60.102 and numerous opacity standards in State implementation plans specify various time exceptions. Many State and local air pollution control agencies use a different approach in enforcing opacity standards than the six-minute average period specified in this revision to Method 9. EPA recognizes that certain types of opacity violations that are intermittent in nature require a different approach in applying the opacity standards than this revision to Method 9. It is EPA's intent to propose an additional revision to Method 9 specifying an alternative method to enforce opacity standards. It is our intent that this method specify a minimum number of readings that must be taken, such as a minimum of ten readings above the standard in any one hour period prior to citing a violation. EPA is in the process of analyzing available data and determining the error involved in reading opacity in this manner and will propose this revision to Method 9 as soon as this analysis is completed. The Agency solicits comments and recommendations on the need for this additional revision to Method 9 and would welcome any suggestions particularly from air pollution control agencies on how we might make Method 9 more responsive to the needs of these agencies.

These actions are effective on November 12, 1974. The Agency finds good cause exists for not publishing these actions as a notice of proposed rulemaking and for making them effective immediately upon publication for the following reasons:

(1) Only minor amendments are being made to the opacity standards which were remanded.

(2) The U.S. Court of Appeals for the District of Columbia instructed EPA to complete the remand proceeding with respect to the Portland cement plant standards by November 5, 1974.

(3) Because opacity standards are the subject of other litigation, it is necessary to reach a final determination with respect to the basic issues involving opacity at this time in order to properly respond to this issue with respect to such other litigation.

These regulations are issued under the authority of sections 111 and 114 of the Clean Air Act, as amended (42 U.S.C. 1857c–6 and 9).

Dated: November 1, 1974.

JOHN QUARLES,
Acting Administrator.

FEDERAL REGISTER, VOL. 39, NO. 219–
—TUESDAY, NOVEMBER 12, 1974

Title 40—Protection of Environment

CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY

[FRL 392-7]

PART 60—STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

Five Categories of Sources in the Phosphate Fertilizer Industry

* * * * *

OPACITY STANDARDS

Many commentators challenged the proposed opacity standards on the grounds that EPA had shown no correlation between fluoride emissions and plume opacity, and that no data were presented which showed that a violation of the proposed opacity standard would indicate simultaneous violation of the proposed fluoride standard. For the opacity standard to be used as an enforcement tool to indicate possible violation of the fluoride standard, such a correlation must be established. The Agency has reevaluated the opacity test data and determined that the correlation is insufficient to support a standard. Therefore, standards for visible emissions for diammonium phosphate plants, triple superphosphate plants, and granular triple superphosphate storage facilities have been deleted. This action, however, is not meant to set a precedent regarding promulgation of visible emission standards. The situation which necessitates this decision relates only to fluoride emissions. In the future, the Agency will continue to set opacity standards for affected facilities where such standards are desirable and warranted based on test data.

In place of the opacity standard, a provision has been added which requires an owner or operator to monitor the total pressure drop across an affected facility's scrubbing system. This requirement will provide an affected facility's scrubbing system. This requirement will provide for a record of the operating conditions of the control system, and will serve as an effective method for monitoring compliance with the fluoride standards.

* * * * *

MONITORING REQUIREMENTS

Several comments were received with regard to the sections requiring a flow measuring device which has an accuracy of ± 5 percent over its operating range. The commentators felt that this accuracy could not be met and that the capital and operating costs outweighed anticipated utility. First of all, "weighbelts" are common devices in the phosphate fertiliser industry as raw material feeds are routinely measured. EPA felt there would be no economic impact resulting from this requirement because plants would have normally installed weighing devices anyway. Second, contacts with the industry led EPA to believe that the ± 5 percent accuracy requirement would be easily met, and a search of pertinent literature showed that weighing devices with ± 1 percent accuracy are commercially available.

* * * * *

Effective date. In accordance with section 111 of the Act, these regulations prescribing standards of performance for the selected stationary sources are effective on August 4, 1975, and apply to sources at which construction or modification commenced after October 22, 1974.

RUSSELL E. TRAIN,
Administrator.

JULY 25, 1975.

FEDERAL REGISTER, VOL. 40, NO. 152–
—WEDNESDAY, AUGUST 6, 1975

PART 60—STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

Emission Monitoring Requirements and Revisions to Performance Testing Methods

On September 11, 1974 (39 FR 32852), the Environmental Protection Agency (EPA) proposed revisions to 40 CFR Part 60, Standards of Performance for New Stationary Sources, to establish specific requirements pertaining to continuous emission monitoring system performance specifications, operating procedures, data These requirements would apply to new and modified facilities covered under Part 60, but would not apply to existing facilities.

Simultaneously (39 FR 32871), the Agency proposed revisions to 40 CFR Part 51, Requirements for the Preparation, Adoption, and Submittal of Implementation Plans, which would require States to revise their State Implementation Plans (SIP's) to include legal enforceable procedures requiring certain specified stationary sources to monitor emissions on a continuous basis. These requirements would apply to existing facilities, which are not covered under Part 60.

Interested parties participated in the rulemaking by sending comments to EPA. A total of 105 comment letters were received on the proposed revisions to Part 60 from monitoring equipment manufacturers, data processing equipment manufacturers, industrial users of monitoring equipment, air pollution control agencies including State, local, and EPA regional offices, other Federal agencies, and consultants. Copies of the comment letters received and a summary of the issues and EPA's responses are available for inspection and copying at the U.S. Environmental Protection Agency, Public Information Reference Unit, Room 2922 (EPA Library), 401 M Street, S.W., Washington, D.C. In addition, copies of the issue summary and EPA responses may be obtained upon written request from the EPA Public Information Center (PM-215), 401 M Street, S.W., Washington, D.C. 20460 (specify Public Comment Summary: Emission Monitoring Requirements). The comments have been carefully considered, additional information has been collected and assessed, and where determined by the Administrator to be appropriate, changes have been made to the proposed regulations. These changes are incorporated in the regulations promulgated herein.

BACKGROUND

At the time the regulations were proposed (September 11, 1974), EPA had promulgated 12 standards of performance for new stationary sources under section 111 of the Clean Air Act, as amended, four of which required the affected facilities to install and operate systems which continuously monitor the levels of pollutant emissions, where the technical feasibility exists using currently available continuous monitoring technology, and where the cost of the systems is reasonable. When the four standards that require monitoring systems were promulgated, EPA had limited knowledge about the operation of such systems because only a few systems had been installed; thus, the requirements were specified in general terms. EPA initiated a program to develop performance specifications and obtain information on the operation of continuous monitoring systems. The program was designed to assess the systems' accuracy, reliability, costs, and problems related to installation, operation, maintenance, and data handling. The proposed regulations (39 FR 32852) were based on the results of this program.

The purpose of regulations promulgated herein is to establish minimum performance specifications for continuous monitoring systems, minimum data reduction requirements, operating procedures, and reporting requirements for those affected facilities required to install continuous monitoring systems. The specifications and procedures are designed to assure that the data obtained from continuous monitoring systems will be accurate and reliable and provide the necessary information for determining whether an owner or operator is following proper operation and maintenance procedures.

SIGNIFICANT COMMENTS AND CHANGES MADE TO PROPOSED REGULATIONS

Many of the comment letters received by EPA contained multiple comments. The most significant comments and the differences between the proposed and final regulations are discussed below.

(1) Subpart A—General Provisions. The greatest number of comments received pertained to the methodology and expense of obtaining and reporting continuous monitoring system emission data. Both air pollution control agencies and affected users of monitoring equipment presented the view that the proposed regulations requiring that all emission data be reported were excessive, and that reports of only excess emissions and retention of all the data for two years on the affected facility's premises is sufficient. Twenty-five commentators suggested that the effectiveness of the operation and maintenance of an affected facility and its air pollution control system could be determined by reporting only excess emissions. Fifteen others recommended deleting the reporting requirements entirely.

EPA has reviewed these comments and has contacted vendors of monitoring and data acquisition equipment for additional information to more fully assess the impact of the proposed reporting requirements. Consideration was also given to the resources that would be required of EPA to enforce the proposed requirement, the costs that would be incurred by an affected source, and the effectiveness of the proposed requirement in comparison with a requirement to report only excess emissions. EPA concluded that reporting only excess emissions would assure proper operation and maintenance of the air pollution control equipment and would result in lower costs to the source and allow more effective use of EPA resources by eliminating the need for handling and storing large amounts of data. Therefore, the regulation promulgated herein requires owners or operators to report only excess emissions and to maintain a permanent record of all emission data for a period of two years.

In addition, the proposed specification of minimum data reduction procedures has been changed. Rather than requiring integrated averages as proposed, the regulations promulgated herein also specify a method by which a minimum number of data points may be used to compute average emission rates. For example, average opacity emissions over a six-minute period may be calculated from a minimum of 24 data points equally spaced over each six-minute period. Any number of equally spaced data points in excess of 24 or continuously integrated data may also be used to compute six-minute averages. This specification of minimum computation requirements combined with the requirement to report only excess emissions provides source owners and operators with maximum flexibility to select from a wide choice of optional data reduction procedures. Sources which monitor only opacity and which infrequently experience excess emissions may choose to utilize strip chart recorders, with or without continuous six-minute integrators; whereas sources monitoring two or more pollutants plus other parameters necessary to convert to units of the emission standard may choose to utilize existing computers or electronic data processes incorporated with the monitoring system. All data must be retained for two years, but only excess emissions need be reduced to units of the standard. However, in order to report excess emissions, adequate procedures must be utilized to insure that excess emissions are identified. Here again, certain sources with minimal excess emissions can determine excess emissions by review of strip charts, while sources with varying emission and excess air rates will most likely need to reduce all data to units of the standard to identify any excess emissions. The regulations promulgated herein allow the use of extractive, gaseous monitoring systems on a time sharing basis by installing sampling probes at several locations, provided the minimum number of data points (four per hour) are obtained.

Several commentators stated that the averaging periods for reduction of monitoring data, especially opacity, were too short and would result in an excessive amount of data that must be reduced and recorded. EPA evaluated these comments and concluded that to be useful to source owners and operators as well as enforcement agencies, the averaging time for the continuous monitoring data should be reasonably consistent with the averaging time for the reference methods used during performance tests. The data reduction requirements for opacity have been substantially reduced because the averaging period was changed from one minute, which was proposed, to six minutes to be consistent with revisions made to Method 9 (39 FR 39872).

Numerous comments were received on proposed § 60.13 which resulted in several changes. The proposed section has been reorganized and revised in several respects to accommodate the comments and provide clarity, to more specifically delineate the equipment subject to Performance Specifications in Appendix B, and to more specifically define requirements for equipment purchased prior to September 11, 1974. The provisions in § 60.13 are not intended to prevent the use of any equipment that can be demonstrated to be reliable and accurate; therefore, the performance of monitoring systems is specified in general terms with minimal references to specific equipment types. The provisions in § 60.13(i) are included to allow owners or operators and equipment vendors to apply to the Administrator for approval to use alternative equipment or procedures when equipment capable of producing accurate results may not be commercially available (e.g. condensed water vapor interferes with measurement of opacity), when unusual circumstances may justify less costly procedures, or when the owner or operator or equipment vendor may simply prefer to use other equipment or procedures that are consistent with his current practices.

Several paragraphs in § 60.13 have been changed on the basis of the comments received. In response to comments that the monitor operating frequency requirements did not consider periods when the monitor is inoperative or undergoing maintenance, calibration, and adjustment, the operating frequency requirements have been changed. Also the frequency of cycling requirement for opacity monitors has been changed to be consistent with the response time requirement in Performance Specification 1, which reflects the capability of commercially available equipment.

A second area that received comment concerns maintenance performed upon continuous monitoring systems. Six commentators noted that the proposed regulation requiring extensive retesting of continuous monitoring systems for all minor failures would discourage proper maintenance of the systems. Two other commentators noted the difficulty of determining a general list of critical components, the replacement of which would automatically require a retest of the system. Nevertheless, it is EPA's opinion that some control must be exercised to insure that a suitable monitoring system is not rendered unsuitable by substantial alteration or a lack of needed maintenance. Accordingly, the regulations promulgated herein require that owners or operators submit with the quarterly report information on any repairs or modifications made to the system during the reporting period. Based upon this information, the Administrator may review the status of the monitoring system with the owner or operator and, if determined to be necessary, require retesting of the continuous monitoring system(s).

Several commentators noted that the proposed reporting requirements are unnecessary for affected facilities not required to install continuous monitoring systems. Consequently, the regulations promulgated herein do not contain the requirements.

Numerous comments were received which indicated that some monitoring systems may not be compatible with the proposed test procedures and requirements. The comments were evaluated and, where appropriate, the proposed test procedures and requirements were changed. The procedures and requirements promulgated herein are applicable to the majority of acceptable systems; however, EPA recognizes that there may be some acceptable systems available now or in the future which could not meet the requirements. Because of this, the regulations promulgated herein include a provision which allows the Administrator to approve alternative testing procedures. Eleven commentators noted that adjustment of the monitoring instruments may not be necessary as a result of daily zero and span checks. Accordingly, the regulations promulgated herein require adjustments only when applicable 24-hour drift limits are exceeded. Four commentators stated that it is not necessary to introduce calibration gases near the probe tips. EPA has demonstrated in field evaluations that this requirement is necessary in order to assure accurate results; therefore, the requirement has been retained. The requirement enables detection of any dilution or absorption of pollutant gas by the plumbing and conditioning systems prior to the pollutant gas entering the gas analyzer.

Provisions have been added to these regulations to require that the gas mixtures used for the daily calibration check of extractive continuous monitoring systems be traceable to National Bureau of Standards (NBS) reference gases. Calibration gases used to conduct system evaluations under Appendix B must either be analyzed prior to use or shown to be traceable to NBS materials. This traceability requirement will assure the accuracy of the calibration gas mixtures and the comparability of data from systems at all locations. These traceability requirements will not be applied whenever the NBS materials are not available. A list of available NBS Standard Reference Materials may be obtained from the Office of Standard Reference Materials, Room B311, Chemistry Building, National Bureau of Standards, Washington, D.C. 20234.

Recertification of the continued accuracy of the calibration gas mixtures is also necessary and should be performed at intervals recommended by the calibration gas mixture manufacturer. The NBS materials and calibration gas mixtures traceable to these materials should not be used after expiration of their stated shelf-life. Manufacturers of calibration gas mixtures generally use NBS materials for traceability purposes, therefore, these amendments to the regulations will not impose additional requirements upon most manufacturers.

(2) Subpart D—Fossil-Fuel Fired Steam Generators. Eighteen commentators had questions or remarks concerning the proposed revisions dealing with fuel analysis. The evaluation of these comments and discussions with coal suppliers and electric utility companies led the Agency to conclude that the proposed provisions for fuel analysis are not adequate or consistent with the current fuel situation. An attempt was made to revise the proposed provisions; however, it became apparent that an in-depth study would be necessary before meaningful provisions could be developed. The Agency has decided to promulgate all of the regulations except those dealing with fuel analysis. The fuel analysis provisions of Subpart D have been reserved in the regulations promulgated herein. The Agency has initiated a study to obtain the necessary information on the variability of sulfur content in fuels, and the capability of fossil fuel fired steam generators to use fuel analysis and blending to prevent excess sulfur dioxide emissions. The results of this study will be used to determine whether fuel analysis should be allowed as a means of measuring excess emissions, and if allowed, what procedure should be required. It should be pointed out that this action does not affect facilities which use flue gas desulfurization as a means of complying with the sulfur dioxide standard; these facilities are still required to install continuous emission monitoring systems for sulfur dioxide. Facilities which use low sulfur fuel as a means of complying with the sulfur dioxide standard may use a continuous sulfur dioxide monitor or fuel analysis. For facilities that elect to use fuel analysis procedures, fuels are not required to be sampled or analyzed for preparation of reports of excess emissions until the Agency finalizes the procedures and requirements.

Three commentators recommended that carbon dioxide continuous monitoring systems be allowed as an alternative for oxygen monitoring for measurement of the amount of diluents in flue gases from steam generators. The Agency agrees with this recommendation and has included a provision which allows the use of carbon dioxide monitors. This provision allows the use of pollutant monitors that produce data on a wet basis without requiring additional equipment or procedures for correction of data to a dry basis. Where CO_2 or O_2 data are not collected on a consistent basis (wet or dry) with the pollutant data, or where oxygen is measured on a wet basis, alternative procedures to provide corrections for stack moisture and excess air must be approved by the Administrator. Similarly, use of a carbon dioxide continuous monitoring system downstream of a flue gas desulfurization system is not permitted without the Administrator's prior approval due to the potential for absorption of CO_2 within the control device. It should be noted that when any fuel is fired directly in the stack gases for reheating, the F and F_c factors promulgated herein must be prorated based upon the total heat input of the fuels fired within the facility regardless of the locations of fuel firing. Therefore, any facility using a flue gas desulfurization system may be limited to dry basis monitoring instrumentation due to the restrictions on use of a CO_2 diluent monitor unless water vapor is also measured subject to the Administrator's approval.

Two commentators requested that an additional factor (F_w) be developed for use with oxygen continuous monitoring systems that measure flue gas diluents on a wet basis. A factor of this type was evaluated by EPA, but is not being promulgated with the regulations herein. The error in the accuracy of the factor may exceed ±5 percent without additional measurements to correct for variations in flue gas moisture content due to fluctuations in ambient humidity or fuel moisture content. However, EPA will approve installation of wet basis oxygen systems on a case-by-case basis if the owner or operator will proposed use of additional measurements and procedures to control the accuracy of the F_w factor within acceptable limits. Applications for approval of such systems should include the frequency and type of additional measurements proposed and the resulting accuracy of the F_w factor under the extremes of operating conditions anticipated.

One commentator stated that the proposed requirements for recording heat input are superfluous because this information is not needed to convert monitoring data to units of the applicable standard. EPA has reevaluated this requirement and has determined that the conversion of excess emissions into units of the standards will be based upon the F factors and that measurement of the rates of fuel firing will not be needed except when combinations of fuels are fired. Accordingly, the regulations promulgated herein require such measurements only when multiple fuels are fired.

Thirteen commentators questioned the rationale for the proposed increased operating temperature of the Method 5 sampling train for fossil-fuel-fired steam generator particulate testing and the basis for raising rather than lowering the temperature. A brief discussion of the rationale behind this revision was provided in the preamble to the proposed regulations, and a more detailed discussion is provided here. Several factors are of primary importance in developing the data base for a standard of performance and in specifying the reference method for use in conducting a performance test, including:

a. The method used for data gathering to establish a standard must be the same as, or must have a known relationship to, the method subsequently established as the reference method.

b. The method should measure pollutant emissions indicative of the performance of the best systems of emission reduction. A method meeting this criterion will not necessarily measure emissions as they would exist after dilution and cooling to ambient temperature and pressure, as would occur upon release to the atmosphere. As such, an emission factor obtained through use of such a method would, for example, not necessarily be of use in an ambient dispersion model. This seeming inconsistency results from the fact that standards of performance are intended to result in installation of systems of emission reduction which are consistent with best demonstrated technology, considering cost. The Administrator, in establishing such standards, is required to identify best demonstrated technology and to develop standards which reflect such technology. In order for these standards to be meaningful, and for the required control technology to be predictable, the compliance methods must measure emissions which are indicative of the performance of such systems.

c. The method should include sufficient detail as needed to produce consistent and reliable test results.

EPA relies primarily upon Method 5 for gathering a consistent data base for particulate matter standards. Method 5 meets the above criteria by providing detailed sampling methodology and includes an out-of-stack filter to facilitate temperature control. The latter is needed to define particulate matter on a common basis since it is a function of temperature and is not an absolute quantity. If temperature is not controlled, and/or if the effect of temperature upon particulate formation is unknown, the effect on an emission control limitation for particulate matter may be variable and unpredictable.

Although selection of temperature can be varied from industry to industry, EPA specifies a nominal sampling temperature of 120° C for most source categories subject to standards of performance. Reasons for selection of 120° C include the following:

a. Filter temperature must be held above 100° C at sources where moist gas streams are present. Below 100° C, condensation can occur with resultant plugging of filters and possible gas/liquid reactions. A temperature of 120° C allows for expected temperature variation within the train, without dropping below 100° C.

b. Matter existing in particulate form at 120° C is indicative of the performance of the best particulate emission reduction systems for most industrial processes. These include systems of emission reduction that may involve not only the final control device, but also the process and stack gas conditioning systems.

c. Adherence to one established temperature (even though some variation may be needed for some source categories) allows comparison of emissions from source category to source category. This limited standardization used in the development of standards of performance is a benefit to equipment vendors and to source owners by providing a consistent basis for comparing test results and predicting control system performance. In comparison, in-stack filtration takes place at stack temperature, which usually is not constant from one source to the next. Since the temperature varies, in-stack filtration does not necessarily provide a consistent definition of particulate matter and does not allow for comparison of various systems of control. On these bases, Method 5 with a sampling filter temperature controlled at approximately 120° C was promulgated as the applicable test method for new fossil-fuel fired steam generators.

Subsequent to the promulgation of the standards of performance for steam generators, data became available indicating that certain combustion products which do not exist as particulate matter at the elevated temperatures existing in steam generator stacks may be collected by Method 5 at lower temperatures (below 160° C). Such material, existing in gaseous form at stack temperature, would not be controllable by emission reduction systems involving electrostatic precipitators (ESP). Consequently, measurement of such condensible matter would not be indicative of the control system performance. Studies conducted in the past two years have confirmed that such condensation can occur. At sources where fuels containing 0.3 to 0.85 percent sulfur were burned, the incremental increase in particulate matter concentration resulting from sampling at 120° C as compared to about 150° C was found to be variable, ranging from 0.001 to 0.008 gr/scf. The variability is not necessarily predictable, since total sulfur oxide concentration, boiler design and operation, and fuel additives each appear to have a potential effect. Based upon these data, it is concluded that the potential increase in particulate concentration at sources meeting the standard of performance for sulfur oxides is not a serious problem in comparison with the particulate standard which is approximately 0.07 gr/scf. Nevertheless, to insure that an unusual case will not occur where a high concentration of condensible matter, not controllable with an ESP, would prevent attainment of the particulate standard, the sampling temperature allowed at fossil-fuel fired steam boilers is being raised to 160° C. Since this temperature is attainable at new steam generator stacks, sampling at temperatures above 160° C would not yield results necessarily representative of the capabilities of the best systems of emission reduction.

In evaluating particulate sampling techniques and the effect of sampling temperature, particular attention has also been given to the possibility that SO_2 may react in the front half of the Method 5 train to form particulate matter. Based upon a series of comprehensive tests involving both source and controlled environments, EPA has developed data that show such reactions do not occur to a significant degree.

Several control agencies commented on the increase in sampling temperature and suggested that the need is for sampling at lower, not higher, temperatures. This is a relevant comment and is one which must be considered in terms of the basis upon which standards are established.

For existing boilers which are not subject to this standard, the existence of higher stack temperatures and/or the use of higher sulfur fuels may result in significant condensation and resultant high indicated particulate concentrations when sampling is conducted at 120° C. At one coal fired steam generator burning coal containing approximately three percent sulfur, EPA measurements at 120° C showed an increase of 0.05 gr/dscf over an average of seven runs compared to samples collected at approximately 150° C. It is believed that this increase resulted, in large part, if not totally, from SO_3 condensation which would occur also when the stack emissions are released into the atmosphere. Therefore, where standards are based upon emission reduction to achieve ambient air quality standards rather than on control technology (as is the case with the standards promulgated herein), a lower sampling temperature may be appropriate.

Seven commentators questioned the need for traversing for oxygen at 12 points within a duct during performance tests. This requirement, which is being revised to apply only when particulate sampling is performed (no more than 12 points are required) is included to insure that potential stratification resulting from air in-leakage will not adversely affect the accuracy of the particulate test.

Eight commentators stated that the requirement for continuous monitoring of nitrogen oxides should be deleted because only two air quality control regions have ambient levels of nitrogen dioxide that exceed the national ambient air quality standard for nitrogen dioxide. Standards of performance issued under section 111 of the Act are designed to require affected facilities to design and install the best systems of emission reduction (taking into account the cost of such reduction). Continuous emission monitoring systems are required to insure that the emission control systems are operated and maintained properly. Because of this, the Agency does not feel that it is appropriate to delete the continuous emission monitoring system requirements for nitrogen oxides; however, in evaluating these comments the Agency found that some situations may exist where the nitrogen oxides monitor is not necessary to insure proper operation and maintenance. The quantity of nitrogen oxides emitted from certain types of furnaces is considerably below the nitrogen oxides emission limitation. The low emission level is achieved through the design of the furnace and does not require specific operating procedures or maintenance on a continuous basis to keep the nitrogen oxides emissions below the applicable standard. Therefore, in this situation, a continuous emission monitoring system for nitrogen oxides is unnecessary. The regulations promulgated herein do not require continuous emission monitoring systems for nitrogen oxides on facilities whose emissions are 30 percent or more below the applicable standard.

Three commentators requested that owners or operators of steam generators be permitted to use NO_x continuous monitoring systems capable of measuring only nitric oxide (NO) since the amount of nitrogen dioxide (NO_2) in the flue gases is comparatively small. The regulations proposed and those promulgated herein allow use of such systems or any system meeting all of the requirements of Performance Specification 2 of Appendix B. A system that measures only nitric oxide (NO) may meet these specifications including the relative accuracy requirement (relative to the reference method tests which measure $NO + NO_x$) without modification. However, in the interests of maximizing the accuracy of the system and creating conditions favorable to acceptance of such systems (the cost of systems measuring only NO is less), the owner or operator may determine the proportion of NO_2 relative to NO in the flue gases and use a factor to adjust the continuous monitoring system emission data (e.g. $1.3 \times NO = NO_x$) provided that the factor is applied not only to the performance evaluation data, but also applied consistently to all data generated by the continuous monitoring system thereafter. This procedure is limited to facilities that have less than 10 percent NO_2 (greater than 90 percent NO) in order to not seriously impair the accuracy of the system due to NO_2 to NO proportion fluctuations.

Section 60.45(g)(1) has been reserved for the future specification of the excess emissions for opacity that must be reported. On November 12, 1974 (39 FR 39872), the Administrator promulgated revisions to Subpart A, General Provisions, pertaining to the opacity provisions and to Reference Method 9, Visual Determination of the Opacity of Emissions from Stationary Sources. On April 22, 1975 (40 FR 17778), the Agency issued a notice soliciting comments on the opacity provisions and Reference Method 9. The Agency intends to evaluate the comments received and make any appropriate revision to the opacity provisions and Reference Method 9. In addition, the Agency is evaluating the opacity standards for fossil-fuel fired steam generators under § 60.42(a)(2) to determine if changes are needed because of the new Reference Method 9. The provisions on excess emissions for opacity will be issued after the Agency completes its evaluation of the opacity standard.

(3) Subpart G—Nitric Acid Plants. Two commentators questioned the long-term validity of the proposed conversion procedures for reducing data to units of the standard. They suggested that the conversion could be accomplished by monitoring the flue gas volumetric rate. EPA reevaluated the proposed procedures and found that monitoring the flue gas volume would be the most direct method and would also be an accurate method of converting monitoring data, but would require the installation of an additional continuous monitoring system. Although this option is available and would be acceptable subject to the Administrator's approval, EPA does not believe that the additional expense this method (monitoring volumetric rate) would entail is warranted. Since nitric acid plants, for economic and technical reasons, typically operate within a fairly narrow range of conversion efficiencies (90–96 percent) and tail gas diluents (2–5 percent oxygen), the flue gas volumetric rates are reasonably proportional to the acid production rate. The error that would be introduced into the data from the maximum variation of these parameters is approximately 15 percent and would usually be much less. It is expected that the tail gas oxygen concentration (an indication of the degree of tail gas dilution) will be rigidly controlled at facilities using catalytic converter control equipment. Accordingly, the proposed procedures for data conversion have been retained due to the small benefit that would result from requiring additional monitoring equipment. Other procedures may be approved by the Administrator under § 60.13(i).

(4) Subpart H—Sulfuric Acid Plants. Two commentators stated that the proposed procedure for conversion of monitoring data to units of the standard would result in large data reduction errors. EPA has evaluated more closely the operations of sulfuric acid plants and agrees that the proposed procedure is inadequate. The proposed conversion procedure assumes that the operating conditions of the affected facility will remain approximately the same as during the continuous monitoring system evaluation tests. For sulfuric acid plants this assumption is invalid. A sulfuric acid plant is typically designed to operate at a constant volumetric throughput (scfm). Acid production rates are altered by by-passing portions of the process air around the furnace or combustor to vary the concentration of the gas entering the converter. This procedure produces widely varying amounts of tail gas dilution relative to the production rate. Accordingly, EPA has developed new conversion procedures whereby the appropriate conversion factor is computed from an analysis of the SO_2 concentration entering the converter. Air injection plants must make additional corrections for the diluent air added. Measurement of the inlet SO_2 is a normal quality control procedure used by most sulfuric acid plants and does not represent an additional cost burden. The Reich test or other suitable procedures may be used.

(5) Subpart J—Petroleum Refineries. One commentator stated that the requirements for installation of continuous monitoring systems for oxygen and firebox temperature are unnecessary and that installation of a flame detection device would be superior for process control purposes. Also, EPA has obtained data which show no identifiable relationship between furnace temperature, percent oxygen in the flue gas, and carbon monoxide emissions when the facility is operated in compliance with the applicable standard. Since firebox temperature and oxygen measurements may not be preferred by source owners and operators for process control, and no

known method is available for translation of these measurements into quantitative reports of excess carbon monoxide emissions, this requirement appears to be of little use to the affected facilities or to EPA. Accordingly, requirements for installation of continuous monitoring systems for measurements of firebox temperature and oxygen are deleted from the regulations.

Since EPA has not yet developed performance specifications for carbon monoxide or hydrogen sulfide continuous monitoring systems, the type of equipment that may be installed by an owner or operator in compliance with EPA requirements is undefined. Without conducting performance evaluations of such equipment, little reliance can be placed upon the value of any data such systems would generate. Therefore, the sections of the regulation requiring these systems are being reserved until EPA proposes performance specifications applicable to H_2S and CO monitoring systems. The provisions of § 60.105(a)(3) do not apply to an owner or operator electing to monitor H_2S. In that case, an H_2S monitor should not be installed until specific H_2S monitoring requirements are promulgated. At the time specifications are proposed, all owners or operators who have not entered into binding contractual obligations to purchase continuous monitoring equipment by [date of publication] will be required to install a carbon monoxide continuous monitoring system and a hydrogen sulfide continuous monitoring system (unless a sulfur dioxide continuous monitoring system has been installed) as applicable.

Section 60.105(a)(2), which specifies the excess emissions for capacity that must be reported, has been reserved for the same reasons discussed under fossil fuel-fired steam generators.

(6) Appendix B—Performance Specifications. A large number of comments were received in reference to specific technical and editorial changes needed in the specifications. Each of these comments has been reviewed and several changes in format and procedures have been made. These include adding alignment procedures for opacity monitors and more specific instructions for selecting a location for installing the monitoring equipment. Span requirements have been specified so that commercially produced equipment may be standardized where possible. The format of the specifications was simplified by redefining the requirements in terms of percent opacity, or oxygen, or carbon dioxide, or percent of span. The proposed requirements were in terms of percent of the emission standard which is less convenient or too vague since reference to the emission standards would have represented a range of pollutant concentrations depending upon the amount of diluents (i.e. excess air and water vapor) that are present in the effluent. In order to calibrate gaseous monitors in terms of a specific concentration, the requirements were revised to delete reference to the emission standards.

Four commentators noted that the reference methods used to evaluate continuous monitoring system performance may be less accurate than the systems themselves. Five other commentators questioned the need for 27 nitrogen oxides reference method tests. The accuracy specification for gaseous monitoring systems was specified at 20 percent, a value in excess of the actual accuracy of monitoring systems that provides tolerance for reference method inaccuracy. Commercially available monitoring equipment has been evaluated using these procedures and the combined errors (i.e. relative accuracy) in the reference methods and the monitoring systems have been shown not to exceed 20 percent after the data are averaged by the specified procedures.

Twenty commentators noted that the cost estimates contained in the proposal did not fully reflect installation costs, data reduction and recording costs, and the costs of evaluating the continuous monitoring systems. As a result, EPA reevaluated the cost analysis. For opacity monitoring alone, investment costs including data reduction equipment and performance tests are approximately $20,000, and annual operating costs are approximately $8,500. The same location on the stack used for conducting performance tests with Reference Method 5 (particulate) may be used by installing a separate set of ports for the monitoring system so that no additional expense for access is required. For power plants that are required to install opacity, nitrogen oxides, sulfur dioxide, and diluent (O_2 or CO_2) monitoring systems, the investment cost is approximately $55,000, and the operating cost is approximately $30,000. These are significant costs but are not unreasonable in comparison to the approximately seven million dollar investment cost for the smallest steam generation facility affected by these regulations.

Effective date. These regulations are promulgated under the authority of sections 111, 114 and 301(a) of the Clean Air Act as amended [42 U.S.C. 1857c–6, 1857c–9, and 1857g(a)] and become effective October 6, 1975.

Dated: September 23, 1975.

JOHN QUARLES,
Acting Administrator.

ENVIRONMENTAL PROTECTION AGENCY

STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

Lignite-Fired Steam Generators

SUBPART D

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 60]

[FRL 650-8]

STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

Lignite-Fired Steam Generators

The Environmental Protection Agency (EPA) is considering amendments to Subpart D of 40 CFR Part 60 (Fossil Fuel-Fired Steam Generators) to establish standards of performance for emissions of nitrogen oxides from new lignite-fired steam generators of greater than 73 megawatts heat input (250 million Btu per hour) and to incorporate the International System of Units (modernized metric system), as applicable.

On December 23, 1971 (36 FR 24877), EPA promulgated standards of performance for fossil fuel-fired steam generators. Included were standards for particulate matter, sulfur divide, and nitrogen oxides applicable to gaseous, liquid, and solid fossil fuel-fired facilities. However, because of a lack of information on nitrogen oxides emissions, lignite-fired facilities were exempted from the nitrogen oxides standard for solid fossil fuels, although they are subject to the standards for particulate matter and sulfur dioxide.

EPA has gathered additional information on lignite-fired facilities and the background materials on the proposed amendment to Subpart D have been published in a report entitled "Standards Support and Environmental Impact Statement, Volume 1: Proposed Standards of Performance for Lignite-Fired Steam Generators", hereafter referred to as SSEIS. Copies are available on request from the EPA Public Information Center (PM-215), Environmental Protection Agency, Washington, D.C. 20460 (specify: Standards Support and Environmental Impact Statement, Volume 1: Proposed Standards of Performance for Lignite-Fired Steam Generators). The information contained in the SSEIS is briefly discussed in this preamble to the proposed standard of performance.

INTERNATIONAL SYSTEM OF UNITS

In accordance with the objective to implement national use of the metric system, EPA presents numerical values in both metric units and English units in its regulations and technical publications. In an effort to simplify use of the metric units of measurement, EPA now uses the International System of Units (SI) as set forth in a publication by the American Society for Testing and Materials entitled "Standard for Metric Practice" (Designation: E 380-76). Therefore, EPA is proposing to revise the appropriate sections of Subpart D to reflect use of SI units.

PROPOSED STANDARD

The proposed standard of performance limits emissions of nitrogen oxides to 260 nanograms per joule of heat input (0.6 pound per million Btu) from lignite-fired steam generators having a capacity greater than 73 megawatts heat input rate (250 million Btu per hour). The proposed standard reflects the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction) has been adequately demonstrated. The best system is considered to be a combination of staged combustion and low excess air.

ECONOMIC AND ENVIRONMENTAL IMPACTS

Based on historical growth rates, it is estimated that 25 new lignite-fired steam generators would be subject to the proposed standard by 1985. The proposed standard would reduce NO_x emissions by 128,000 Mg/yr (141,000 T/yr). Controlling NO_x emissions to the level of the proposed standard would result in insignificant increases in capital and annualized costs for the utility.

Since approximately 90 percent of lignite-fired steam generators of rated capacity greater than 73 MW heat input are owned by electric utilities, the cost of complying with the proposed standard was analyzed for the lignite utility industry. The cost to the utilities appears to be negligible relative to the capital investment costs. Available information indicates that, at most, nitrogen oxides control would increase capital investment costs by only 0.5 percent for a new lignite-fired utility boiler and ancillary equipment. This cost increase for NO_x control represents an estimated increase of two dollars per installed kilowatt relative to an estimated typical cost of about 400 dollars per installed kilowatt capacity based on costs for a bituminous coal-fired boiler island. The costs for NO_x control would have negligible effect on power costs to consumers. The review of the economic impact has shown that the proposal is not a major action under the Inflationary Impact Statement (IIS) program, and no IIS is needed.

The environmental impact of the proposed standard is beneficial since the increase in emissions due to growth of lignite-fired steam generators would be minimized. The proposed standard should result in a 20 percent reduction in the mass of nitrogen oxide emissions from new lignite-fired boilers. It would reduce the atmospheric burden of nitrogen oxides and would help prevent increased ambient oxidant concentrations in areas where lignite-fired steam generators will be located (primarily North Dakota and Texas). There are no adverse environmental impacts associated with the proposed standard. Control techniques required to comply with the proposed standard do not cause boiler efficiency losses, and thus there are no incremental energy demands associated with the proposed standard. A complete analysis of the economic and environmental impacts may be found in Chapters VI and VIII of the SSEIS.

CONTROL SYSTEMS

Nitrogen oxides from fossil-fuel combustion are formed via two mechanisms: (1) Thermal fixation (oxidation) of atmospheric nitrogen (N_2) in the combustion air, and (2) oxidation of organic nitrogen in the fuel. Oxidation of N_2 can be prevented by reducing the level of thermal excitation in the flame by means of (a) flue gas recirculation, (b) staged combustion, (c) water injection, (d) reduced air preheat, or (e) combinations of these techniques. Nitrogen oxides emissions due to the oxidation of organic nitrogen in the fuel can be controlled by using fuels with small amounts of organic nitrogen and by removing oxygen from the volatilization zone by means of (a) low excess air, (b) staged combustion, and/or (c) fuel/air mixing pattern adjustment (burner design). Fuels such as coal, residual oil, and lignite contain 0.2 to 1.5 percent organic nitrogen, and oxidation of this fuel-nitrogen may be responsible for as much as 80–90 percent of the total nitrogen oxides emissions from pulverized coal combustion. Therefore, the organic nitrogen content of fuel may be a limiting factor in controlling nitrogen oxides emissions. The fact that the organic nitrogen content of the U.S. lignites does not vary appreciably precludes nitrogen oxides control by switching to lignite with a lower organic nitrogen content.

Water injection and reduced air preheat significantly reduce the efficiency of a steam generator, and consequently are not practical nitrogen oxides control methods. Flue gas recirculation does not reduce nitrogen oxides emissions caused by the oxidation of the organic nitrogen in the lignite and it adversely affects the efficiency of a steam generator. Therefore, low excess air (LEA), staged combustion (SC), low emission burners, and combined LEA and SC are considered the most feasible control systems.

In addition to the control systems just discussed, the fuel burning equipment design parameters can affect the amount of nitrogen oxides emitted and the degree to which the control systems are effective. Lignite-firing has been demonstrated in pulverized-fired, cyclone-fired, and stoker-fired steam generating units. Stoker-fired units have the lowest heat release rate and thus have lower nitrogen oxides emissions than the other type units but are limited in physical size and are not expected to be of importance in future lignite-fired steam generating units. Cyclone-fired units have the highest heat release rate and the highest nitrogen oxides emissions. Pulverized-fired units have a lower heat release rate than cyclone-fired units, but a higher release rate than stoker-fired units.

EPA TEST PROGRAM

Of the 15 lignite-fired units in domestic operation in 1974, four utility sized units were chosen for EPA's test program. Included were three pulverized-fired units (two tangentially-fired and one horizontally opposed-fired), and one cyclone-fired unit.

Operating with low excess air and/or staged combustion, all types of fuel burning equipment exhibited reduced nitrogen oxides emissions over baseline conditions. The horizontally opposed- and cyclone-fired units are more responsive to nitrogen oxides control techniques on a percentage basis, but the tangentially-fired units using staged combustion yielded the lowest nitrogen oxides emissions. Cyclone-fired units cannot be dependably operated with low excess air firing or staged combustion because of flame instability problems; however, staged combustion of cyclone-fired units can be achieved by firing auxiliary fuel.

On the basis of the test data, it appears that the cyclone-fired units cannot consistently meet a nitrogen oxides standard more stringent than 340 nanograms per joule (0.8 pound per million Btu). The test data also indicate that horizontally opposed-fired units would have difficulty consistently achieving a nitrogen oxides standard of 260 nanograms per joule (0.6 pound million Btu) over a long time period. However, development of low emission burners appears promising for application to horizontally opposed-fired units, and such units should be able to attain a standard of 260 nanograms per joule. Tangentially-fired units should have no difficulty meeting a standard of 260 nanograms per joule.

RATIONALE FOR PROPOSED STANDARDS

In deciding the nitrogen oxides limit for the proposed standard, EPA considered proposing the same standard for lignite-fired steam generators as the present standard for coal-fired steam generators, 300 nanograms per joule (0.7 pound per million Btu). In the study on control of nitrogen oxides emissions from lignite-fired steam generators, staged combustion and low excess air were found to reduce emissions significantly below 300 nanograms per joule input (0.7 pound per million Btu). The measured emission levels of 172 to 220 nanograms per joule heat input (0.4 to 0.5 pound per million Btu) indicated that the present standard for coal-fired units would not require use of best demonstrated control technology, considering costs, for lignite-fired units. Studies on control of nitrogen oxides emissions by combustion modification techniques have shown emission levels for modern bituminous and subbituminous coal-fired utility sized units to be similar to those observed for lignite-fired units. The lower emission levels observed for the lignite and bituminous fired units reflect an improvement in combustion modification techniques and in the design of the burners and of boilers between 1970 and 1974.

Tangentially-fired units could most likely meet a standard of 220 nanograms per joule (0.5 pound per million Btu). This standard, however may not be consistently achievable by the horizontally-opposed fired boilers. Since the manufacturers of those units do not make tangentially-fired boilers, a standard of 220 nanograms per joule could leave only one manufacturer of complying boilers, which would remove the option of power companies to obtain competitive bids. EPA requests comments on the following issues: (1) Whether horizontally-opposed fired boilers could meet a standard of 220 nanograms per joule; (2) if not, what would be the effect on the competitive balance of the equipment manufacturing industry; (3) what would be the effects on the power industry; and (4) whether EPA can consider these factors in setting standards based on the best system of emission reduction which has been adequately demonstrated.

The proposed standard of 260 nanograms per joule for lignite-fired steam generators is based on emission and cost data currently available to the Administrator. The proposed standard, while numerically more stringent than the present standard for coal-fired units, will require lignite-fired units to apply the same type of combustion modifications as coal-fired units. EPA recognizes that lignite-fired cyclone units cannot achieve the proposed standard of 260 nanograms per joule (0.6 pound per million Btu); therefore, EPA has considered the impact such a standard would have on boiler manufacturers and on the lignite-fired steam generating industry. EPA determined that the impact on boiler manufacturers of indirectly prohibiting cyclone-fired units would be negligible. Only one boiler manufacturer markets cyclone-fired units and that manufacturer also markets pulverized-fired units. Effective prohibition of cyclone-fired units is expected to have little effect on this manufacturer because these units represent a minor percentage of the total annual sales for the manufacturer.

The impact of the proposed standard on the lignite-fired steam generating industry is not well defined. EPA has attempted to determine whether units other than cyclone-fired units are available that will meet the proposed standard and if any cost or operating reliability advantages exist between these units and the cyclone-fired units. For large lignite-fired steam generators an alternative to cyclone-fired units is pulverized-fired units. From consultations with the major boiler manufacturers EPA concluded that cyclone-fired units do not have any significant investment cost advantages over an equivalent pulverized-fired unit. Thus, the impact of the prohibition of cyclone-fired units is dependent on the relative operational advantages of cyclone-fired units over pulverized-fired units.

Almost all of the large lignite-fired units in North Dakota have experienced severe operational difficulties as a result of ash fouling of the boiler tube surfaces. Utility boilers firing Texas lignites have not experienced ash fouling problems to the same degree. Research conducted by the Energy Research and Development Administration (ERDA) in Grand Forks, North Dakota, has shown that the sodium content of the lignite is highly correlated with the degree of ash fouling. Lignite ash with three to five percent sodium is considered to have a moderate to high fouling potential, and a sodium content greater than five percent has a severe fouling potential. In EPA's judgment, the ash fouling problem can be minimized by designing the boiler with more soot blowers in the convective passes than normal, with larger spacing between boiler tubes, and with design of the furnace temperature profile to control tube metal temperatures.

Some of the lignite utilities have claimed that cyclone-fired units can burn lignites with the higher sodium content more reliably than pulverized-fired units because a smaller proportion of the ash enters the boiler. The utilities cited the Minnkota Power Cooperative's cyclone-fired unit at Young-Center station as a successful example. This cyclone-fired, 235 MW boiler was selected and designed based on a cooperative study to develop a better method for firing high sodium lignite. The unit has an excellent record of operating availability since its startup in 1970. However, the unit has not fired the high sodium lignites for which it was designed. In addition, the operating reliability of this unit may be attributed to furnace design features other than the cyclone burner. Since startup of the Minnkota cyclone-fired unit, two additional cyclone-fired units have been placed in commercial operation by power companies and cooperatives in the area. Each of these units has been in operation for less than a year. Both units have been firing lignites of approximately 4 to 6 percent sodium and have been experiencing problems with ash fouling of the boiler tubes and with furnace slagging to different degrees. Since numerous operating problems typically occur in the first year of operation of a steam generator, more operating experience is needed before the performance and reliability of these units on high sodium lignite is evaluated.

Experience with pulverized-fired units is presently limited to two units designed in the early 1960's. At that time problems with plugging in the convective passages because of ash fouling associated with firing high sodium lignite were not fully appreciated. Consequently, these two units were retrofitted with an increased number of sootblowers and the tube spacings were increased in order to obtain reliable operation of the units. Redesign of this nature was implemented to different degrees on the units. The more extensively retrofitted unit has operated reliably for six years on lignite with four to six percent sodium in the ash and on eight to nine percent sodium lignite for the past year. The less extensively retrofitted unit can be reliably operated by maintaining the sodium content of the fuel below five percent. Based on this experience, new cyclone or pulverized lignite-fired units are designed with greater furnace surface area, increased superheater tube spacing, and increased number of sootblowers. This early experience with pulverized firing apparently has not convinced the utilities that pulverized firing of high sodium lignite is impractical. In the early 1970's, the United Power Association (UPA) purchased two pulverized-fired units, after evaluating bids on both cyclone and pulverized-fired units. These tangentially-fired 500 MW boilers were guaranteed to reliably fire a lignite with a design range of 0.1 to 4.8 percent sodium.

This selection of a pulverized-fired unit for a North Dakota lignite with high fouling potential indicates that pulverized-fired units are price competitive with cyclone-fired units and that at least one utility believes that cyclone-fired units are not required for use of a lignite with high fouling potential.

In addition to this limited experience with firing high sodium lignite, preliminary results from a study conducted by ERDA showed that cyclone-fired units have a statistically significant lower ash deposition rate than pulverized-fired units. The test was conducted while the units were firing 3.5 to 4.5 percent sodium lignite and insufficient information is available to allow comparison at higher sodium levels. One possible interpretation of these data is that cyclone-fired units can operate on high sodium lignite (greater than six percent) more reliably than pulverized-fired units. However, the study's results are not consistent with the experience of operating commercial units and the data may not warrant drawing this conclusion.

EPA has concluded from evaluation of the available information that (1) while there are differences in operational characteristics of pulverized and cyclone-fired units, both types can reliably operate on high sodium lignite and (2) cyclone-fired units do not have significant operation maintenance, or cost advantages over pulverized-fired units. The manufacturers of pulverized-fired units believe that these units can be as effective as cyclone-fired units for burning lignites, including those with high sodium. Combustion Engineering, which is installing the units for UPA, is confident that pulverized-fired units can be properly designed to handle the ash fouling and slagging problems of high sodium lignite. Babcock and Wilcox, the other major supplier of lignite-fired units, also believes that a pulverized-fired unit can be designed to reliably burn high sodium lignite. Due to the limited information available at this time and different possible interpretations of the information, EPA realizes that the assessment of relative reliability of pulverized and cyclone-fired units for firing high sodium lignite is debatable. Therefore, EPA is requesting that all interested persons submit factual information on this issue during the comment period. Factual information is specifically requested on the following areas of interest:

1. Investment costs and operation and maintenance costs for either pulverized-fired or cyclone-fired large steam generators designed for moderate or high sodium lignite.

2. The differences, if any, in the design of the convection section or the gas temperature profile between cyclone and pulverized-fuel fired steam generators. The comparison should discuss any differences in the number, type or location of sootblowers installed, frequency of operation of soot blowers, comparison of tube spacings or depth of tube banks and other relevant factors.

3. Relative importance of factors considered in selecting a cyclone- or pulverized-fired unit.

It is expected that the above information will allow EPA an opportunity to assess the relative costs of cyclone and pulverized fuel fired lignite steam generators as well as to assess the need for cyclone-fired units for use of high sodium lignite. The final standard will reflect the conclusions drawn from evaluation of all available factual information. EPA will limit the scope of coverage of the final standard if the data submitted during the comment period justify such a change. The scope of coverage could be limited by applying the standard to lignites having a specified sodium content, by establishing a separate standard for cyclone-fired units, or exempting cyclone-fired units.

It should be noted that standards of performance for new sources established under section 111 of the Clean Air Act reflect emission limits achievable with the best adequately demonstrated systems of emission reduction considering the cost of such systems. State implementation plans (SIP's) approved or promulgated under section 110 of the Act, on the other hand, must provide for the attainment and maintenance of national ambient air quality standards (NAAQS) designed to protect public health and welfare. For that purpose SIP's must in some cases require greater emission reductions than those required by standards of performance for new sources. In addition, States are free under section 116 of the Act to establish more stringent emission limits than those established under section 111 or those necessary to attain or maintain the NAAQS under section 110. Thus, new and existing sources may in some cases be subject to limitations more stringent than EPA's standards of performance under section 111.

PUBLIC PARTICIPATION

In accordance with section 117(f) of the Act, publication of these proposed amendments to 40 CFR Part 60 was preceded by consultation with appropriate advisory committees, independent experts, and Federal departments and agencies. Interested persons may participate in this rulemaking by submitting written comments (in triplicate) to the Emission Standards and Engineering Division, Environmental Protection Agency (MD-13), Research Triangle Park, North Carolina 27711, Attention: Mr. Don R. Goodwin. All comments received not later than 60 days from (date of proposal) will be considered. Copies of comments received will be available for inspection and copying during normal business hours at the Public Information Reference Unit, Room 2922 (EPA Library), 401 M Street, SW., Washington, D.C.

(Secs. 111, 114 and 301(a) of the Clean Air Act, as amended by sec. 4(a) of Pub. L. 91-604, 84 Stat. 1678 and by sec. 15(c)(2) of Pub. L. 91-604, 84 Stat. 1713 (42 U.S.C. 1857c-6, 1857c-9, and 1857g(a)))

The Environmental Protection Agency has determined that this document does not contain a major proposal requiring preparation of an Inflation Impact Statement under Executive Order 11821 and OMB Circular A-107.

Dated: December 15, 1976.

RUSSELL E. TRAIN,
Administrator.

It is proposed to amend Part 60 of Chapter I, Title 40 of the Code of Federal Regulations by revising Subparts A and D as follows:

Subpart A—General Provisions

1. Section 60.2 is amended by substituting the International System of Units (SI) in paragraph (1) as follows:

§ 60.2 Definitions.

* * * * *

(1) "Standard conditions" means a temperature of 293 K (68°F) and a pressure of 101.3 kilopascals (29.92 in. Hg).

* * * * *

Subpart D—Standards of Performance for Fossil Fuel-Fired Steam Generators

2. Section 60.41 is amended by adding paragraph (f) as follows:

§ 60.41 Definitions.

* * * * *

(f) "Coal" means all solid fossil fuels classified as anthracite, bituminous, subbituminous, or lignite by A.S.T.M. Designation D 388-66.

3. Section 60.44 is amended by adding paragraph (a)(4) and by revising paragraph (b) as follows:

§ 60.44 Standard for nitrogen oxides.

(a) * * *

(4) 260 nanograms per joule heat input (0.60 pound per million Btu) derived from lignite.

(b) When different fossil fuels are burned simultaneously in any combination, the applicable standards (in ng/J) shall be determined by proration. Compliance shall be determined by using the following formula:

$$PS_{NO} = \frac{w(260) + x(86) + y(130) + z(300)}{w + x + y + z}$$

where:

PS_{NO_x} is the prorated standard for nitrogen oxides when burning different fuels simultaneously, in nanograms per joule heat input derived from all fossil fuels fired or from all fossil fuel and wood residue fired;

w is the percentage of total heat input derived from lignite;

x is the percentage of total heat input derived from gaseous fossil fuel;

y is the percentage of total heat input derived from liquid fossil fuel;

z is the percentage of total heat input derived from solid fossil fuel (except lignite or a solid fossil fuel containing 25 pct, by weight, or more of coal refuse).

When a solid fossil fuel containing 25 percent, by weight, or more of coal refuse is burned in combination with gaseous, liquid or other solid fossil fuel, or wood residue, the standard for nitrogen oxides does not apply.

4. Section 60.45 is amended by adding paragraph (f)(4)(vi) as follows:

§ 60.45 Emission and fuel monitoring.

* * * * *

(f) * * *

(4) * * *

(vi) For lignite coal as classified according to A.S.T.M. D 388-66, $F = 2.659 \times 10^{-7}$ dscm/J (9900 dscf/million Btu) and $F_c = 0.516 \times 10^{-7}$ scm CO_2/J (1920 scf CO_2/million Btu).

[FR Doc.76-37484 Filed 12-21-76;8:45 am]

ENVIRONMENTAL
PROTECTION
AGENCY

STANDARDS OF
PERFORMANCE FOR NEW
STATIONARY SOURCES

PETROLEUM REFINERY

SUBPART J

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 60]

[FRL 610-7]

STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

Petroleum Refinery Sulfur Recovery Plants

Notice is hereby given that under the authority of section 111 of the Clean Air Act, as amended, the Administrator is proposing standards of performance for new, modified or reconstructed petroleum refinery sulfur recovery plants.

The Administrator is also proposing a new reference method to be used for determining emissions of hydrogen sulfide and reduced sulfur compounds from petroleum refinery sulfur recovery plants.

PROPOSED STANDARDS

As proposed, the standards would apply to petroluem refinery sulfur recovery plants. Generally, these plants are physically located within petroleum refineries. Occasionally, however, refineries will pipe the sulfur-rich gas stream to a nearby facility, such as a chemical plant, where the sulfur is recovered. The standards would apply to all refinery sulfur recovery plants, whether they are physically located within a petroleum refinery, or within the confines of another facility.

The standards would limit the concentration of sufur dioxide (SO_2) in the gases discharged to the atmosphere to 0.025 percent by volume at zero percent oxygen and on a dry basis. Where the emission control system installed to comply with these standards discharges residual emissions of hydrogen sulfide (H_2S), carbonyl sulfide (COS), and carbon disulfide (CS_2), the standards would limit the concentration of H_2S and the total concentration of H_2S, COS and CS_2 (calculated as SO_2) in the gases discharged to the atmosphere, to 0.0010 percent and 0.030 percent by volume at zero percent oxygen and on a dry basis, respectively.

ENVIRONMENT AND ECONOMIC IMPACTS

The proposed standards would require new, modified or reconstructed refinery sulfur recovery plants to reduce emissions by about 99 percent compared to emissions from existing refinery sulfur recovery plants. This would increase the overall sulfur recovery of a typical refinery sulfur recovery plant from about 94 percent to about 99.9 percent.

It is expected that the proposed standards would apply to about 80 new refinery sulfur plants by 1980. Few, if any, modifications or reconstructions of existing refinery sulfur plants are anticipated. The proposed standards would reduce national sulfur dioxide emissions from these new refinery sulfur plants by about 55,000 tons per year.

This reduction in national SO_2 emissions would be obtained without adverse impacts on other aspects of the environment, such as increased solid waste disposal, water pollution, or noise. The proposed standards would also result in a reduction in the growth of national energy consumption by some 54 million kw-hr/yr, or about 90,000 barrels of fuel oil per year, by 1980.

The economic impact of the proposed standards would be reasonable both on large and on small refiners, although it is somewhat more severe on small refiners than large refiners. For the small refiner [processing less than 30,000 barrels per calendar day (BCD)], the proposed standards could reduce profitability, as measured by return on assets, by 1.5 to 7.5 percent. A price increase of only 0.25 to 1.0 percent on all petroleum products, however, would restore the small refiner's profitability. The impact on a large refiner (processing more than 30,000 BCD) is considerably less due to economies of scale. The proposed standards could reduce the profitability of a large refiner by 0.5 to 1.5 peroent. A price increase of only 0.10 to 0.30 percent on all petroleum products, however, would restore the large refiner's profitability. Consequently, the proposed standards would not adversely affect the growth of either the large refinery or the small refiner sector of the domestic refining industry.

To comply with these proposed standards, the investment required by the domestic refining industry would total some $110 million (MM) over the five-year period from 1976 to 1980; the annual operating costs of the industry would increase by some $16 MM per year by 1980 and petroleum product prices could increase by 0.1 to 1.0 percent.

The review of the economic impact has shown that the proposal is not a major action under the Inflationary Impact Statement (IIS) program and no IIS is needed.

SELECTION OF SOURCE CATEGORY AND AFFECTED FACILITIES

Section 111 of the Clean Air Act directs the Administrator to establish standards of performance for new stationary sources of air pollution which may contribute significantly to air pollution which causes or contributes to the endangerment of public health or welfare. Sulfur recovery plants are a major source of SO_2 emissions in petroleum refineries. Although a few State or local regulations already require emission control equivalent to the proposed standards, most State regulations require less stringent control of refinery sulfur recovery plants.

Reducing SO_2 emissions from new, modified or reconstructed refinery sulfur recovery plants takes on importance in view of the expected growth in the numbers and sizes of these plants, and the urban location of many petroleum refineries where high ambient air concentrations of SO_2 already exist. Current growth projections for the domestic petroleum refining industry, for example, indicate that refinery sulfur recovery plant capacity will double between 1976 and 1980.

Considering these factors, the proposed standards have been developed to limit emissions of SO_2 from petroleum refinery sulfur recovery plants. Some of the emission control systems that might be installed to reduce emissions of SO_2, however, discharge residual emissions of hydrogen sulfide (H_2S), carbonyl sulfide (COS) and carbon disulfide (CS_2) to the atmosphere. The proposed standards, therefore, include limits on emissions of these pollutants.

RATIONALE

Two alternative systems of SO_2 emission control were considered as candiates to serve as the basis for standards of performance: (1) the low-temperature extended Claus reaction system (alternative I) and (2) various tail gas scrubbing systems (alternative II). The alternative I systems reduce emisssion from uncontrolled refinery sulfur recovery plants by 80–85 percent, while the alternative II systems reduce emissions by 98–99 percent. Overall sulfur recovery of the refinery sulfur plant is increased from 95 to 99.9 percent with the use of an alternative II system.

Standards of performance based on alternative I would have an essentially negligible impact on SO_2 emissions since most state implementation plans (SIP's) already require equivalent control. As outlined above, however, standards based on alternative II would reduce SO_2 emissions by about 90 percent below levels required by most SIP's and would lead to a reduction in national SO_2 emissions of some 55,000 tons per year in 1980. Standards based on alternative II would also have no adverse environmental impacts in other areas such as increased water pollution, solid waste disposal, energy consumption, or noise. In addition, the economic impact of standards based on alternative II would be reasonable both on large and on small refiners. Consequently, alternative II represents the best system of emission reduction and the proposed standards are based on this alternative.

The tail gas scrubbing systems of alternative II, however, include two different types of emission control systems for reducing SO_2 emissions from refinery sulfur recovery plants: oxidation control systems and reduction control systems. In the oxidation control system, the SO_2 emissions from a refinery sulfur plant are controlled directly by tail gas scrubbing. In the reduction control system, the SO_2 emissions are first converted to H_2S emissions which are then controlled by tail gas scrubbing. Residual emissions discharged into the atmosphere from oxidation control systems or from reduction control systems which are followed by incineration consist of SO_2. Residual emissions discharged from reduction control systems which are not followed by incineration, however, consist of H_2S, COS (carbonyl sulfide) and CS_2 (carbon disulfide). Standards limiting emissions of SO_2, therefore, while appropriate for oxidation control systems or reduction control systems followed by incineration, are not appropriate for reduction control systems not followed by incineration.

Where reduction control systems which are not followed by incineration are properly operated and maintained, emissions of reduced sulfur compounds (H_2S, COS and CS_2) are insignificant. With poor operation and maintenance, however, emissions of these pollutants from these systems could lead to significant odor problems, primarily from the H_2S emitted. This situation presents a difficulty in selecting which pollutants should be controlled under the proposed standards due to the provisions of section 111(d) of the Act. Sulfur dioxide is a criteria pollutant for which State control of existing sources is not required under section 111(d) (since such control is already required by section 110). Reduced sulfur compounds, on the other hand, would be considered designated pollutants subject to the provisions of section 111(d).

Under the EPA regulations implementing section 111(d), after promulgation of a standard of performance for the control of such a designated pollutant, EPA must develop a guideline document containing the necessary information for States to develop plans for controlling emissions of the pollutant (40 CFR 60.22). In this case the document would have to cover information pertinent to the control of reduced sulfur compounds from all existing petroleum refinery sulfur plants which have installed reduction control systems which are not followed by incineration. After final issuance of the guideline document by EPA, all States containing affected plants are required by 40 CFR 60.23 to develop such plans and submit them to EPA for approval. Currently, about 25 refinery sulfur plants in seven States have installed reduction control systems which are not followed by incineration. Developing the guideline document and State plans, therefore, could be a significant undertaking, requiring the expenditure of considerable resources at the Federal level and by seven States and their local governments. Thus, one purpose of this proposal is to solicit comments from the affected States as to the burden imposed by the implementation of section 111(d) in this case.

If that burden imposed by the implementation of section 111(d) is great, EPA will consider the course of declining to require the adoption and submittal of State plans under 40 CFR 60.24. This option is available due to the unusual factual situation: all existing refinery sulfur plant, which have installed reduction control systems which are not followed by incineration (25 plants in seven States) already have very low emissions of reduced sulfur compounds. Their emission control systems have been installed to comply with State or local air pollution control regulations limiting emissions of SO_2 from existing refinery sulfur plants. To ensure that the installation of these emission control systems do not lead to local odor problems, these regulations also limit emissions of reduced sulfur compounds either directly or indirectly. Where emissions of reduced sulfur compounds are limited directly, local regulations specify the maximum concentrations of H_2S and reduced sulfur compounds (H_2S, COS and CS_2) that can be present in the tail gases discharged to the atmosphere. Where this approach has been followed, emissions of H_2S are limited to 10 ppm and emissions of reduced sulfur compounds are limited to either 300 or 500 ppm.

Where emissions of reduced sulfur compounds are limited indirectly by local regulations, these regulations require that the best available emission control technology be installed. In the process of specifying the best emission control technology, local air pollution control agencies have contacted EPA, vendors of various emission control system, and other local air pollution control agencies where these emission control systems have been installed. In terms of limiting emissions of reduced sulfur compounds, this approach has achieved the same end result as the direct regulatory approach. All 25 reduction control system which are now operating have been designed and guaranteed by the vendors of these systems to limit emissions to less than 10 ppm H_2S and less than 300 or 500 ppm reduced sulfur compounds.

Consequently, the current 25 petroleum refinery sulfur plants which have installed reduction control systems which are not followed by incineration are not considered by EPA to be significant sources of reduced sulfur compound emissions. Developing State plans under section 111(d) to control emissions of these pollutants from these facilities, therefore, would not reduce existing emission levels.

On the other hand, if EPA were to propose standards of performance for refinery sulfur plants only for SO_2 without limiting emissions of reduced sulfur compounds, this action could be interpreted to mean that EPA does not consider the potential air pollution problem posed by emissions of reduced sulfur compounds to be important. Such an interpretation could encourage new plants to be built without limiting emissions of these pollutants.

Having determined that the proposed regulation should cover emissions of reduced sulfur compounds from new refinery sulfur recovery plants, but not existing ones, EPA is left with the problem of selecting the appropriate pollutants to control with the proposed standards. Limiting emissions of SO_2 alone would be unsatisfactory due to the risk of reduced sulfur compound pollution from new plants. Limiting reduced sulfur compound emissions as well as SO_2 for new sources will cause some expenditure of effort on the part of EPA and the affected States which is not in fact necessary to achieve control of existing plants.

Considering all the facets of this situation, EPA proposes to limit emissions of both SO_2 and reduced sulfur compounds by these standards of performance, fulfilling the intent of section 111 of the Act to prevent new air pollution problems by requiring new, modified, or reconstructed plants to install the best systems of emission reduction considering costs. However, EPA is considering two alternative routes for treating the problem of existing sources. One alternative is for EPA to issue a guideline document under 40 CFR 60.22 (based primarily on the information available in the support documents for these standards of performance) and to require the seven affected States to submit plans under 40 CFR 60.23. Those States that already regulate reduced sulfur compounds by State law will be able to submit relatively simple control plans. Those States in which regulation of reduced sulfur compounds has been accomplished by local ordinances may have to provide for State enforcement before their control plans can be approved.

If the first alternative appears to be excessively burdensome, EPA is also considering a second alternative, because the 25 existing sources are well controlled. The purpose of limiting pollutant emissions from existing sources under the provisions of section 111(d) is to control a pollutant which may cause or contribute to the endangerment of public health or welfare, but is not known to be "hazardous" within the meaning of section 112, and is not controlled under sections 108 through 110. Since action under section 111(d) in this instance would not further control the pollutant in question, and existing refinery sulfur plants which have installed reduction control systems not followed by incineration are not endangering the public health or welfare, the conclusion can be drawn that there is no purpose to limiting emissions of these pollutants under section 111(d). Under this alternative, EPA would not issue a guideline document, the chain of events requiring States to develop plans for controlling emissions of these pollutants would not be initiated and these plans would not be developed. (A detailed discussion of this alternative may be found in the Standards Support and Environmental Impact Statement for Petroleum Sulfur Recovery Plants.)

The data and information available for selecting specific emission limits include the results of emission tests both by the Agency and by local air pollution control agencies, discussions with owners and operators which have installed and are now operating either the oxidation control systems or the reduction control systems, and discussions with the vendors of these emission control systems. The SO_2 emission limit is based on emission tests at a refinery sulfur plant controlled by an oxidation control system and at a refinery sulfur plant controlled by a reduction control system followed by incineration. The H_2S and reduced sulfur compound emission limits are based on emission source tests at three refinery sulfur plants controlled by reduction control systems not followed by incineration. The numerical values were selected including a reasonable margin for error taking into consideration the limited data base, the relative "newness" of the plants tested, pilot-plant data available from vendors on long-term operation, and the experience of owners and operators with these emission control systems.

The 0.025 percent by volume limit for SO_2 emissions and the 0.030 percent by volume limit for reduced sulfur compound emissions are also equivalent, in the sense that both require achieving the same degree of overall sulfur recovery (i.e., 99.9 percent). The numerical limit on SO_2 emissions is lower due to the somewhat greater volume of gases discharged from oxidation control systems and reduction control systems followed by incineration, which is inherent in their design and operation.

It should be noted that standards of performance for new sources established under section 111 of the Clean Air Act reflect emission limits achievable with the best adequately demonstrated system of emission reduction considering the cost of such systems. State implementation plans (SIP's) approved or promulgated under section 110 of the Act, on the other hand, must provide for the attainment and maintenance of national ambient air quality standards (NAAQS) designed to protect public health and welfare. For that purpose SIP's must in some cases require greater emission reductions than those required by standards of performance for new sources. Indeed, building of new sources may be precluded altogether in some geographical areas. In addition, States are free under section 116 of the Act to establish more stringent emission limits than those established under section 111 or those necessary to attain or maintain the NAAQ under section 110. Thus, new sources may in some cases be subject to limitations more stringent than EPA's standards of performance under section 111, and prospective owners and operators of new sources should be aware of this possibility in planning for such facilities.

ENERGY

The impact of the proposed standards on the energy consumption of a refinery sulfur recovery plant varies depending on the type of emission control system installed to comply with the standards. If an oxidation control system or a reduction control system followed with incineration were used, the overall energy consumption of a typical sulfur recovery plant would be increased by some 30 percent. If a reduction control system not followed by incineration were used, however, the overall energy consumption would be reduced by some 50 percent. These percentages are high primarily because refinery sulfur recovery plants consume little energy. Typically, for example, a refinery sulfur recovery plant accounts for less than 1 percent of the total energy consumed within a petroleum refinery.

Assuming half of the refinery sulfur recovery plants affected by the proposed standards by 1980 install oxidation control systems or reduction control systems followed by incineration and half install reduction control systems not followed by incineration, the proposed standards would reduce national energy consumption in 1980 by some 54 million kw-hr/yr, or about 90,000 barrels of fuel oil per year.

MONITORING, TESTING, AND RECORDKEEPING

As proposed, the regulations would require monitoring of emissions released to the atmosphere to insure that the emission control systems installed to comply with the proposed standards are properly maintained and operated. If an oxidation control system or a reduction control system followed by incineration were installed, monitoring of SO_2 emissions would be required and if a reduction control system not followed by incineration were installed, monitoring of H_2S and reduced sulfur compound emissions would be required.

Emission monitoring systems for SO_2 are readily available and performance specifications for these monitors have already been promulgated by EPA in 40 CFR Part 60 Appendix B. Although a few emission monitoring systems for H_2S and reduced sulfur compounds are available, EPA has not yet developed performance specifications for these monitors. Consequently, until EPA proposes and promulgates these performance specifications, owners and operators subject to the requirement to install H_2S and reduced sulfur compound emission monitors will not be required to do so. The requirement to install these monitors is included in the proposed regulations; however, to ensure that when EPA promulgates these performance specifications, those owners and operators who have installed reduction control systems not followed by incineration which are subject to the proposed standards will be required to retrofit these monitors. This will enable enforcement personnel to ensure that these emission control systems are being properly operated and maintained.

The reference method for determining compliance also depends on the emission control system employed to comply with the proposed standards. If an oxidation control system or a reduction control system followed by incineration were installed, Method 6—Determination of Sulfur Dioxide Emissions from Stationary Sources would be used to determine emissions of SO_2. If a reduction control system not followed by incineration were installed, the proposed Reference Method 15—Determination of Hydrogen Sulfide and Reduced Sulfur Compound Emissions from Sulfur Recovery Plants would be used to determine emissions of H_2S and total emissions of H_2S, COS, and CS_2 (calculated as SO_2).

The proposed Reference Method 15 is based on gas chromatographic separation followed by flame photometric detection. This method permits separation and identification of each individual pollutant (i.e., H_2S, COS and CS_2). To determine compliance with the proposed standards, a sample of the gases discharged to the atmosphere is analyzed to determine emissions of H_2S, COS and CS_2. The concentration of H_2S in these gases is determined directly. The concentration of reduced sulfur compounds in these gases is determined indirectly, by adding together the concentrations of H_2S, COS and CS_2. Since emissions are calculated as SO_2, however, the concentrations of CS_2 (having twice the sulfur per molecule of gas) is multiplied by two before adding it to the concentrations of H_2S and COS.

AMENDMENT OF SUBPART J OF PART 60

The proposed standards would be incorporated into 40 CFR Part 60 by amending Subpart J—Standards of Performance for Petroleum Refineries. Maintaining clarity within Subpart J while incorporating the proposed standards requires amendment of a number of existing paragraphs. In all but the case discussed below, these paragraphs have merely been rewritten with no change in content or intent.

Recently, it has been brought to the attention of the Administrator that as Subpart J is now written, a fluid catalytic cracking unit incinerator waste-heat boiler is an affected facility subject to the standard limiting emissions of particulate matter. Thus, if an owner or operator installs an incinerator waste-heat boiler, that boiler must comply with the standard on particulate emissions.

An incinerator waste-heat boiler, however, is an emission control device which reduces emissions of carbon monoxide from a fluid catalytic cracking unit catalyst regenerator. It was not EPA's intent that installation of an emission control device to reduce carbon monoxide emissions would then require installation of another emission control device to reduce particulate emissions. Rather, the intent was to consider the fluid catalytic cracking unit catalyst regenerator together with any associated incinerator waste-heat boiler in terms of controlling particulate emissions. If an incinerator waste-heat boiler which burns additional liquid or solid fossile fuel is in use, an increase in total particulate emissions would be permitted, consistent with good control of particulate emissions from the combustion of that increment of fuel. Accordingly, fluid catalytic cracking unit incinerator waste-heat boilers have been deleted from the list of affected facilities. This amendment of Subpart J, however, is not a change in the intent of the existing standard of performance limiting emissions of particulate matter.

PUBLIC PARTICIPATION

As prescribed by section 111 of the Clean Air Act as amended, this proposal of standards of performance has been preceded by the Administrator's determination that refinery sulfur recovery plants contribute significantly to air pollution which causes or contributes to the endangerment of public health or welfare. By publication of this determination in this issue of the FEDERAL REGISTER he adds petroleum refinery sulfur recovery plants to the list of affected facilities under the source category of petroleum refineries. In accordance with section 117 of the Act, publication of these proposed standards was preceded by consultation with appropriate advisory committees, independent experts, and Federal departments and agencies.

Interested persons may participate in this rulemaking by submitting written comments (in triplicate) to the Emission Standards and Engineering Division, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, Attention: Mr. Don R. Goodwin. The Administrator will welcome comments on all aspects of the proposed regulations, including the designation of sulfur recovery plants as a significant contributor to air pollution which causes or contributes to the endangerment of public health or welfare, economic and technological issues, and the proposed test method.

Comments are invited specifically on the severity of the economic impact of the proposed standards on the small refiner, since a number of interested parties have expressed objection to the absence of a lower level cut-off exempting the small refiner from compliance with the standards. Any comments submitted to the Administrator on this issue, however, should contain specific information and data pertinent to an evaluation of the magnitude of this impact and its severity.

Also, the Administrator would be especially interested in receiving comments regarding the issue of controlling reduced sulfur compound emissions without implementing section 111(d), particularly as this would affect the seven States involved.

All relevant comments received on or before December 3, 1976 will be considered. Comments received will be available for public inspection and copying at the EPA Public Information Reference Unit, Room 2922 (EPA Library), 401 M Street, SW., Washington, D.C. 20460.

Background information on these proposed standards of performance has been published in a document "Standard Support and Environmental Impact Statement—Standards of Performance for Petroleum Refinery Sulfur Plants." This document presents the factors considered in the development of the proposed standards, including alternative emission control systems, emission test data, environmental impact, costs and economic considerations. Copies of the document are available free of charge by writing to the Public Information Center (PM-215), U.S. Environmental Protection Agency, Washington, D.C. 20460 (specify "Standards Support and Environmental Impact Statement—Standards of Performance for Petroleum Refinery Sulfur Plants").

Authority. This notice of proposed rulemaking is issued under the authority of sections 111, 114 and 301(a) of the Clean Air Act, as amended (42 U.S.C. 1857c-6 and 9).

Dated: September 16, 1976.

JOHN QUARLES,
Acting Administrator.

It is proposed to amend 40 CFR Part 60 as follows:

Subpart J—Standards of Performance for Petroleum Refineries

1. Section 60.100 is revised as follows:

§ 60.100 Applicability and designation of affected facility.

The provisions of this subpart are applicable to the following affected facilities in petroleum refineries: fluid catalytic cracking unit catalyst regenerators, fuel gas combustion devices, and sulfur recovery plants.

2. Section 60.101 is amended by adding paragraphs (i) through (l) as follows:

§ 60.101 Definitions.

*   *   *   *   *

(i) "Sulfur recovery plant" means a process unit which converts hydrogen sulfide produced within a petroleum refinery to elemental sulfur. The sulfur recovery plant need not be physically located within a petroleum refinery.

(j) "Oxidation control system" means an emission control system which reduces emissions from sulfur recovery plants by converting these emissions to sulfur dioxide.

(k) "Reduction control system" means an emission control system which reduces emissions from sulfur recovery plants by converting these emissions to sulfur dioxide.

(k) "Reduction control system" means an emission control system which reduces emissions from sulfur recovery plants by converting these emissions to hydrogen sulfide.

(1) "Reduced sulfur compounds" mean hydrogen sulfide (H_2S), carbonyl sulfide (COS) and carbon disulfide (CS_2).

3. Section 60.102 is amended by revising paragraph (a) introductory text and paragraph (b) as follows:

§ 60.102 Standard for particulate matter.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall discharge or cause the discharge into the atmosphere from any fluid catalytic cracking unit catalyst regenerator:

*   *   *   *   *

(b) Where the gases discharged by the fluid catalytic cracking unit catalyst regenerator pass through an incinerator or waste heat boiler in which auxiliary or supplemental liquid or solid fossil fuel is burned, particulate matter in excess of that permitted by paragraph (a)(1) of this section may be emitted to the atmosphere, except that the incremental rate of particulate matter emissions shall not exceed 43.0 g/MJ (0.10 lb/million Btu) of heat input attributable to such liquid or solid fossil fuel.

4. Section 60.104 is amended by revising paragraph (a) as follows:

§ 60.104 Standard for sulfur dioxide.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall:

(1) Burn in any fuel gas combustion device any fuel gas which contains hydrogen sulfide in excess of 230 mg/dscm (0.10 gr/dscf), except that the gases resulting from the combustion of fuel gas may be treated to control sulfur dioxide emissions provided the owner or operator demonstrates to the satisfaction of the Administrator that this is as effective in preventing sulfur dioxide emissions to the atmosphere.

(2) Discharge or cause the discharge of any gases into the atmosphere from any sulfur recovery plant containing in excess of:

(i) 0.025 percent by volume of sulfur dioxide at zero percent oxygen on a dry basis if emissions are controlled by an oxidation control system, or a reduction control system followed by incineration, or

(ii) 0.030 percent by volume of reduced sulfur compounds and 0.0010 percent by volume of hydrogen sulfide calculated as sulfur dioxide at zero percent oxygen on a dry basis if emissions are controlled by a reduction control system not followed by incineration.

*   *   *   *   *

5. Section 60.105 is amended by adding paragraphs (a) (4) and (5) and (e) (3) (i) and (ii) as follows:

§ 60.105 Emission monitoring.

(a) * * *

(4) An instrument for continuously monitoring and recording concentrations of H_2S in fuel gases burned in any fuel gas combustion device, if compliance with § 60.104(a) is achieved by removing H_2S from the fuel gas before it is burned; or an instrument for continuously monitoring and recording concentrations of SO_2 in the gases discharged into the atmosphere from the combustion of any fuel gas, if compliance with § 60.104(a) is achieved by removing SO_2 from the combusted fuel gases. If the concentration of H_2S is monitored, fuel gas combustion devices having a common source of fuel gas may be monitored at one location, if monitoring at this location accurately represents the concentration of H_2S in the fuel gas burned.

(5) An instrument for continuously monitoring and recording concentrations of SO_2 in the gases discharged into the atmosphere from the sulfur recovery plant if compliance with § 60.104(b) is achieved through the use of an oxidation control system, or a reduction control system followed by incineration; or an instrument for continuously monitoring and recording concentrations of H_2S and reduced sulfur compounds in the gases discharged into the atmosphere from the sulfur recovery plant if compliance with § 60.104(b) is achieved through the use

of a reduction control system not followed by incineration.

* * * * *

(e) * * *

(1) [Reserved]

(2) [Reserved]

(3) Sulfur dioxide. (i) Any hourly period during which the average concentration of H_2S in fuel gas combusted in any fuel gas combustion device subject to § 60.104(a) exceeds 230 mg/dscm (0.10 gr/dscf), if compliance with § 60.104(a) is achieved by removing H_2S from the fuel gas before it is burned; or any hourly period during which the average concentration of SO_2 in the gases discharged into the atmosphere from any fuel gas combustion device subject to § 60.104(a) exceeds the level specified in § 60.104(a), if compliance with § 60.104(a) is achieved by removing SO_2 from the combusted fuel gases.

(ii) Any four-hour period during which the average concentration of SO_2 in the gases discharged into the atmosphere from any sulfur recovery plant subject to § 60.104(b) exceeds the level specified in § 60.104(b)(1) if compliance with § 60.104(b) is achieved through the use of an oxidation control system or a reduction control system followed by incineration; or any four-hour period during which the average concentration of H_2S, or reduced sulfur compounds in the gases discharged into the atmosphere from any sulfur plant subject to § 60.104(b) exceeds the levels specified in § 60.104(b)(2) if compliance with § 60.104(b) is achieved through the use of reduction control systems not followed by incineration.

6. Section 60.106 is amended by revising paragraphs (c) and (d) as follows:

§ 60.106 Test methods and procedures.

* * * * *

(c) For the purpose of determining compliance with § 60.104(a), Method 11 shall be used to determine the concentration of H_2S and Method 6 shall be used to determine the concentration of SO_2.

(1) If Method 11 is used, the gases sampled shall be introduced into the sampling train at approximately atmospheric pressure. Where refinery fuel gas lines are operating at pressures substantially above atmosphere, this may be accomplished with a flow control valve. If the line pressure is high enough to operate the sampling train without a vacuum pump, the pump may be eliminated from the sampling train. The sample shall be drawn from a point near the centroid of the fuel gas line. The minimum sampling time shall be 10 minutes and the minimum sampling volume 0.01 dscm (0.35 dscf) for each sample. The arithmetic average of two samples of equal sampling time shall constitute one run. Samples shall be taken at approximately 1-hour intervals. For most fuel gases, sample times exceeding 20 minutes may result in depletion of the collecting solution, although fuel gases containing low concentrations of hydrogen sulfide may necessitate sampling for longer periods of time.

(2) If Method 6 is used, Method 1 shall be used for velocity traverses and Method 2 for determining velocity and volumetric flow rate. The sampling site for determining SO_2 concentration by Method 6 shall be the same as for determining volumetric flow rate by Method 2. The sampling point in the duct for determining SO_2 concentration by Method 6 shall be at the centroid of the cross section if the cross sectional area is less than 5 m² (54 ft²) or at a point no closer to the walls than 1 m (30 inches) if the cross sectional area is 5 m² or more and the centroid is more than one meter from the wall. The sample shall be extracted at a rate proportional to the gas velocity at the sampling point. The minimum sampling time shall be 10 minutes and the minimum sampling volume 0.01 dscm (0.36 dscf) for each sample. The arithmetic average of two samples of equal sampling time shall constitute one run. Samples shall be taken at approximately one-hour intervals.

(d) For the purpose of determining compliance with § 60.104(b), Method 6 shall be used to determine the concentration of SO_2 and Method 15 shall be used to determine the concentration of H_2S and reduced sulfur compounds.

(1) If Method 6 is used, the procedure outlined in paragraph (c)(2) of this section shall be followed except that each run shall span a minimum of four consecutive hours of continuous sampling. A number of separate samples may be taken for each run, provided the total sampling time of these samples adds up to a minimum of four consecutive hours. Where more than one sample is used, the average SO_2 concentration for the run shall be calculated as the time weighted average of the SO_2 concentration for each sample according to the formula:

$$C_S=\sum_{i=1}^{N} C_{S_i}\frac{t_{S_i}}{T}$$

Where:

C_S = SO_2 concentration for the run.

N = Number of samples.

C_{S_i} = SO_2 concentration for sample i.

t_{S_i} = Continuous sampling time of sample i.

T = Total continuous sampling time of all N samples.

(2) If Method 15 is used, each run shall consist of 16 samples taken over a minimum of four hours. The sampling point shall be at the centroid of the cross section of the duct if the cross sectional area is less than 5 m² (54 ft²) or at a point no closer to the walls than 1 m (30 inches) if the cross sectional area is 5 m² or more and the centroid is more than 1 meter from the wall. To insure minimum residence time for the sample inside the sample lines, the sampling rate shall be at least 3 liters/minute (0.1 ft³/min). The SO_2 equivalent for each run shall be calculated as the arithmetic average of the SO_2 equivalent of each sample during the run. Reference Method 4 shall be used to determine the moisture content of the gases. The sampling point for Method 4 shall be adjacent to the sampling point for Method 15. The sample shall be extracted at a rate proportional to the gas velocity at the sampling point. Each run shall span a minimum of four consecutive hours of continuous sampling. A number of separate samples may be taken for each run provided the total sampling time of these samples adds up to a minimum of four consecutive hours. Where more than one sample is used, the average moisture content for the run shall be calculated as the time weighted average of the moisture content of each sample according to the formula:

$$B_{wo}=\sum_{i=1}^{N} B_{oi}\left[\frac{t_{oi}}{T}\right]$$

B_{wo} = Proportion by volume of water vapor in the gas stream for the run.

N = Number of samples.

B_{oi} = Proportion by volume of water vapor in the gas stream for the sample i.

t_{oi} = Continuous sampling time for sample i.

T = Total continuous sampling time of all N samples.

* * * * *

ENVIRONMENTAL PROTECTION AGENCY

■

BASIC OXYGEN PROCESS FURNACES

Standards of Performance For New Stationary Sources

SUBPART N

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 60]

[FRL 684-5]

STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

Iron and Steel Plants: Basic Oxygen Process Furnaces

Notice is hereby given that under sections 111, 114, and 301 of the Clean Air Act, as amended, the Administrator is proposing amendments to the standards of performance for basic oxygen process furnaces (BOPF).

SUMMARY OF PROPOSED AMENDMENTS

The proposed amendments to the standards of performance for BOPF facilities would limit the opacity of emissions from the control device, require monitoring of operations of the control device, and clarify the term "startup" as it applies to BOPF facilities. Compliance with the proposed opacity limits would be determined by conducting observations in accordance with Reference Method 9. The continuous monitoring of operations is specific to venturi scrubber emission control equipment because all presently planned facilities will be controlled by venturi scrubbers. The proposed monitoring provisions require continuous monitoring of the pressure loss across the throat of the scrubber and the water supply pressure to the scrubber. As the provisions of 40 CFR 60.11(c) apply to BOPF facilities, "startup" means the setting into operation of a BOPF which has been out of production for a continuous time period of eight hours or the setting into operation of a relined BOPF.

BACKGROUND

On June 11, 1973 (38 FR 15406), the Administrator proposed as Subpart N to 40 CFR Part 60, standards of performance for new basic oxygen process furnaces (BOPFs). The proposed standards limited particulate matter emissions to no more than 50 mg/dscm (0.022 gr/dscf) and to less than 10 percent opacity except for two minutes in any one hour. Commenters on the proposed standards pointed out the inappropriateness of the two minutes per hour exemption for the cyclic steel production process and the unachievability of the level of the proposed opacity standard. Evaluation of the comments on the proposed standard led EPA to conclude that further study was required for development of adequate provisions. On March 8, 1974 (39 FR 9308), the Administrator promulgated the standard of performance limiting emissions from new BOPFs to less than 50 mg/dscm; however, the opacity standard and the attendant continuous monitoring requirement were not promulgated at that time. The opacity standard was reserved pending study of (1) the reasons for the observed variations in the opacity of emissions from well-controlled facilities and (2) the effect that exempting periods of startup, shutdown, and malfunction from applicability of opacity standards would have on the level of the opacity standard and the need for a time exemption.

On November 12, 1974 (39 FR 39872), EPA revised Reference Method 9 and the general provisions applicable to opacity standards of performance. Reference Method 9, the method for determining compliance with opacity standards, was revised to require that opacity observations be recorded at 15-second intervals with a minimum of 24 observations (six minutes), to obtain sufficient observations to ensure acceptable accuracy. The use of sets of opacity observations (or six-minute average opacity values) precludes a single high reading from being considered a violation. In addition, § 60.11(e) was added to the general provisions to provide a means for an owner or operator to petition EPA to obtain a higher opacity standard for any facility that demonstrates compliance with the mass standard concurrent with failure to achieve the opacity standard. Section 60.11(e) allows opacity standards to be established at levels which reflect the maximum expected effects of the normal range of operating variables and stack diameters at well-controlled new facilities.

In light of the Method 9 revisions and the questions on the appropriate emission limitation and format for the opacity standard, additional opacity data were obtained and the bases and rationale for an opacity standard for BOPFs were thoroughly reevaluated. The reevaluation included consideration of the effects on opacity of process variations, of variations in performance characteristics of control devices, and of definition of startup periods for BOPFs. The proposed opacity standards are established at levels which are achievable by well-maintained and properly operated control equipment capable of reducing emissions to the level of the concentration standard, 50 mg/dscm (0.22 gr/dscf). Copies of the report on the data bases and rationale for the proposed opacity standard may be obtained upon written request from the EPA Public Information Center (PM-215), Environmental Protection Agency, Washington, D.C. 20460 (specify: Background Information for an Opacity Standard of Performance for Basic Oxygen Process Furnaces in Iron and Steel Plants).

ENVIRONMENTAL AND INFLATIONARY IMPACT

Opacity standards are set at levels which ensure proper operation and maintenance of the control system, but which do not require use of a more efficient system. The opacity standards and the continuous monitoring requirements proposed herein do not impose any additional significant requirements or costs over those required to comply with the concentration standard. Therefore, this proposal is not considered a major action under the Inflationary Impact Statement (IIS) program and no IIS is required. The environmental impacts of the standards of performance for BOPFs also are incurred in complying with the concentration standard. During the development of the concentration standard, the intermedia effects of the standard were assessed and determined to be negligible. No additional intermedia effects would be incurred in complying with opacity standards for BOPFs. Therefore, a formal environmental impact statement has not been prepared. The environmental impact of the proposed opacity standards is beneficial as the standards would ensure compliance of new BOPFs with the concentration standard throughout their operational life.

DATA BASE FOR A STANDARD

The standard of performance limits emissions from all new basic oxygen process furnaces to less than 50 mg/dscm (0,22 gr/dscm). Emissions from basic oxygen process furnaces can be controlled to this level by use of a well-designed and operated high energy venturi scrubber or an electrostatic precipitator. In the development of an opacity standard for BOPFs, opacity observations were conducted at six facilities according to the procedures of Method 9 (39 FR 39872). Because of a known difference between the particle size distributions, and hence light scattering properties, of emissions from bottom blown BOPFs and top blown BOPFs, the opacity of emissions from both type furnaces were investigated in the background study on a standard.

The facilities observed in the study were representative of several control levels based on available particulate matter emission data and an engineering judgment of the current condition of the control system. The condition of the control system was assessed on the basis of review of operating parameters, design parameters, and maintenance condition of the control system. From the observation of six facilities, it was noted that higher emissions occurred at the beginning of the steel production cycle for both types of control systems. The higher opacity emissions are attributable to the greater evolution rate of particulate matter and the lower gas temperature at the start of the oxygen blow as well as a lag in the response of the control device. For scrubber-controlled top or botton blown BOPFs the six minute average opacity levels observed at the start of oxygen blow were less than 20 percent, and the six minute average opacity levels during the remainder of the cycle were less than 10 percent opacity. Electrostatic precipitator controlled facilities exhibited opacity levels less than 30 percent during the start of oxygen blow and levels less than 16 percent during the remainder of the cycle. The difference between the opacity levels observed for the two types of control systems primarily reflects differences in diameter of discharge stacks rather than significant differences in the performance.

RATIONALE FOR THE PROPOSED STANDARD

Section 111 of the Act requires EPA to set emission standards which reflect "the degree of emission limitation achievable through application of the best system of emission reduction which (taking into account the cost of achieving such reduction) the Administrator determines has been adequately demonstrated." The standards of performance require an owner or operator to conduct a performance test after the initial startup of an affected facility to ensure that the control system was properly designed and installed. Section 111(e) of the Act requires that new sources continue to be in compliance with the standards throughout their operational life. Opacity standards are established in conjunction with mass or concentration standards as a means of ensuring that control equipment is adequately maintained and properly operated at all times between performance tests.

In EPA's judgment, the opacity levels associated with well-designed and operated facilities differed by type of control system due to design features. Therefore, selection of the emission limitation for the standard required consideration of whether the level would ensure proper operation and maintenance of all facilities. In the development of the proposed standard EPA considered several alternative regulatory approaches. The alternatives considered included opacity levels based on data from electrostatic precipitator-controlled facilities, separate opacity limitations for electrostatic precipitator-controlled and scrubber-controlled facilities, and an opacity level based on data from scrubber-controlled facilities. An opacity standard based on performance of electrostatic precipitator-controlled systems was not selected because the standard would not require proper operation and maintenance of venturi scrubber-controlled facilities. In addition, the steel industry currently has no plans for the construction of any new electrostatic precipitator-controlled BOPF facilities, thus this standard would not accomplish its intended purpose. Setting separate opacity standards for the two control systems was also rejected because only one of the control systems is expected to be used. Thus the proposed opacity standard is based on the performance of scrubber-controlled facilities. Should any affected BOPF be controlled with an electrostatic precipitator and comply with the particulate limit of 50 mg/dscm but not the opacity limits, a separate opacity limit would be established for that facility under 40 CFR 60.11(e). The provisions of 40 CFR 60.11(e) allow owners or operators of sources which exceed the opacity standard while concurrently achieving the concentration standard to request establishment of a specific opacity standard for that facility.

The proposed standard would limit peak opacity which occurs at the beginning of the cycle and the opacity over the remainder of the cycle. The opacity limit for the beginning of the cycle is necessary because of the increased particulate loading and gas density at the startup of the operation. Emissions during the period of startup of the production cycle are not excluded from the opacity standard as a "startup" under the provisions of 40 CFR 60.11(c) because emissions during this period are subject to the concentration standard and are controllable.

The proposed standard would limit emissions during the beginning of the production cycle to less than 20 percent opacity and emissions over the remainder of the cycle to less than 10 percent opacity. To simplify enforcement, the opacity standard would allow the period of higher opacity emissions to occur once per steel production cycle. Restriction of the higher opacity emission period to the beginning of the production cycle would require the observer to synchronize observations with shop operations. In addition, the proposed standard could be enforced more readily at facilities with several furnaces ducted to a single, common control system.

Standards of performance for new sources established under section 111 of the Clean Air Act reflect emission limits achievable with the best adequately demonstrated systems of emission reduction considering the cost of such systems. State implementation plans (SIP's) approved or promulgated under section 110 of the Act, on the other hand, must provide for the attainment and maintenance of national ambient air quality standards (NAAQS) designed to protect public health and welfare. For that purpose SIP's must in some cases require greater emission reductions than those required by standards of performance for new sources. In addition, States are free under section 116 of the Act to establish more stringent emission limits than those established under section 111 or those necessary to attain or maintain the NAAQS under section 110. Thus, new and existing sources may in some cases be subject to limitations more stringent than EPA's standards of performance under section 111.

PUBLIC PARTICIPATION

In accordance with section 117(f) of the Act, publication of these proposed amendments to 40 CFR Part 60 was preceded by consultation with appropriate advisory committees, independent experts, and Federal departments and agencies. Interested persons may participate in this rulemaking by submitting written comments (in triplicate) to the Emission Standards and Engineering Division, Environmental Protection Agency, Research Triangle Park, North Carolina, 27711, Attention: Mr. Don R. Goodwin. Comments on all aspects of the proposed amendments to the regulation are welcome, including economic and technological issues. All comments received not later than May 2, 1977, will be considered. Comments received will be available for public inspection at the EPA Public Information Reference Unit (EPA Library), Room 2922, 401 M. Street, SW., Washington, D.C. 20460.

(Sec. 111, 114, 301(a), Clean Air Act, as amended, Pub. L. 91-604, 84 Stat. 1676 (42 U.S.C. 1857c-6, 1857c-9, 1857g(a)).)

NOTE.—The Environmental Protection Agency has determined that this document does not contain a major proposal requiring preparation of an Economic Impact Statement under Executive Order 11949.

Dated: February 23, 1977.

JOHN QUARLES,
Acting Administrator.

It is proposed to amend Part 60 of Chapter I, Title 40 of the Code of Federal Regulations as follows:

1. The table of sections is amended by revising Subpart N as follows:

Subpart N—Standards of Performance for Iron and Steel Plants

* * * * *

Sec.
60.143 Monitoring of operations.

* * * * *

2. Section 60.3 is amended by adding a new abbreviation as follows:

§ 60.3 Abbreviations.

* * * * *

Pa—pascal.

* * * * *

Subpart N—Standards of Performance for Iron and Steel Plants

3. Section 60.142 is amended by adding paragraph (a)(2) and (b) as follows:

§ 60.142 Standard for particulate matter.

(a) * * *

* * * * *

(2) Exit from a control device and exhibit 10 percent opacity or greater, except that an opacity of greater than 10 percent but less than 20 percent may occur once per steel production cycle.

(b) For purposes of this subpart, "startup" means the setting into operation of a BOPF which has been out of production for a minimum continuous time period of eight hours or the setting into operation of a relined BOPF

4. A new § 60.143 is added as follows:

§ 60.143 Monitoring of operations.

(a) The owner or operator of an affected facility shall maintain daily records of the time and duration of each steel production cycle.

(b) The owner or operator of any affected facility that uses venturi scrubber emission control equipment shall install, calibrate, maintain, and continuously operate the following monitoring devices:

(1) A monitoring device for the continuous measurement of the pressure loss through the venturi construction of the control equipment. The monitoring device is to be certified by the manufacturer to be accurate within ±250 Pa (±1 inch water).

(2) A monitoring device for the continuous measurement of the water supply pressure to the control equipment. The monitoring device is to be certified by the manufacturer to be accurate within ±5 percent of the design water supply pressure. The pressure sensor or tap must be located close to the water discharge point. The Administrator may be consulted for approval of alternative locations for the pressure sensor or tap.

(c) All monitoring devices required under paragraph (b) of this section are to be recalibrated annually, and at other times as the Administrator may require, in accordance with the procedures under § 60.13(b)(3).

(d) Any owner or operator subject to requirements under paragraph (b) of this section shall report for each calendar quarter all measurement results that are more than 10 percent below the average levels maintained during the most recent performance test conducted under § 60.8 which the affected facility demonstrated compliance with the standard under § 60.142(a)(1). The accuracy of the respective measurements, not to exceed the values specified in paragraphs (b)(1) and (b)(2) of this section, may be taken into consideration when determining the measurement results that must be reported.

(Secs. 111, 114, 301(a), Clean Air Act, as amended, Pub. L. 91-604, 84 Stat. 1678 (42 U.S.C. 1857c-6, 1857c-9, 1857g(a)).)

[FR Doc.77-5982 Filed 3-1-77;8:45 am]

ENVIRONMENTAL PROTECTION AGENCY

STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

Kraft Pulp Mills

SUBPART BB

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 60]

[FRL 605-2]

KRAFT PULP MILLS

Standards of Performance for New Stationary Sources

Notice is hereby given that under the authority of section 111 of the Clean Air Act, as amended, the Administrator is proposing standards of performance for new and modified kraft pulp mills. The Administrator also is proposing to amend Appendix A, Reference Methods, in Part 60 by adding a reference method for the measurement of total reduced sulfur (TRS) emissions and an alternate method for the measurement of particulate matter.

PROPOSED STANDARDS

The proposed standards would limit emissions of particulate matter from three affected facilities at kraft pulp mills. The limits are: (1) 0.10 gram per dry standard cubic meter (g/dscm) for recovery furnaces, (2) 0.15 gram per kilogram of air-dried pulp (g/kg ADP) for smelt dissolving tanks, (3) 0.15 g/dscm for lime kilns when burning natural gas, and (4) 0.30 g/dscm for lime kilns when burning oil. Visible emissions from recovery furnaces would be limited to 35 percent opacity.

Under the proposed standards, TRS emissions would be limited to 5 parts per million (ppm) by volume from seven affected facilities: Digester systems, brown stock washer systems, multiple-effect evaporator systems, black liquor oxidation systems, recovery furnaces, lime kilns, and condensate stripper systems. In addition, a TRS standard of 0.025 g/kg ADP is proposed for smelt dissolving tanks.

ENVIRONMENTAL IMPACT

The proposed standards would reduce particulate emissions from new kraft pulp mills more than 99 percent below the levels that would result from no control and more than 50 percent below the average levels that are being achieved by typical existing facilities in the United States. Emissions of TRS would be reduced by more than 95 percent below the uncontrolled levels and more than 80 percent below the average levels for existing sources.

TRS emissions from kraft pulp mills are extremely odorous, and there are numerous instances of poorly controlled kraft mills creating public odor problems. The proposed standards include limitations on TRS emissions, rather than on the intensity of odors produced by kraft pulp mills, because this course of action would ensure more objective and efficient enforcement. The proposed standards would prevent odor problems from most newly constructed kraft pulp mills, except in the immediate vicinity of the mills on occasions when meteorological conditions produce downwash of stack plumes. The proposed standards would substantially reduce ground level ambient air concentrations of particulate matter around new kraft pulp mills below current levels found around existing mills.

The secondary environmental impact of the proposed standards would be minor. No additional solid waste handling or disposal problems would be caused by the standards because the additional particulate matter collected from recovery furnace systems, smelt dissolving tanks, and lime kilns can be recycled to the kraft pulping process. Increased water demand and treatment would be slight because mill process water can be used in scrubbing systems for lime kilns and smelt dissolving tanks, and the scrubbing system effluent could be recirculated to the kraft pulping process with no increased effluent. The increased mud washing necessitated by the standard could increase water demand. A relatively small amount of particulate matter, sulfur dioxide, and nitrogen oxides would be discharged into the air if the power plant that supplies the additional electrical power required by the standards is fired with fossil fuel.

ENERGY IMPACT

The energy requirements of the proposed standards have been evaluated. Compared to the requirements of the average State standards, the incremental energy that would be required to control all new, modified, and replaced affected facilities at kraft pulp mills by 1981 has been estimated at an equivalent of about 1,440,000 barrels of Number 6 fuel oil per year. The magnitude of this requirement indicates that the proposed standards would not have a major impact on the imbalance between national energy demand and domestic supply.

The incremental energy requirements of the proposed standards would be generated by the use of fans or pumps to circulate exhaust gases or scrubbing liquids through control devices, and the direct consumption of natural gas or fuel oil to incinerate exhaust gases or maintain process conditions that reduce the generation of pollutants. The incremental energy represents an increase of approximately 4.3 percent above the process energy requirements for new kraft pulp mills.

ECONOMIC IMPACT

The proposed regulations could affect an estimated 17 million tons of kraft pulping capacity by 1981. About a third of that capacity would be affected as a result of mill capacity expansions. The remainder would be affected via replacement of depreciated designated facilities. It is projected that the equivalent of 33 new mills or expansions at existing mills, with a capacity of 500 T ADP/day, will occur through 1980. Replacement of existing depreciated designated facilities will result at an estimated 35 mills.

Total incremental investment costs through 1981 are projected to be $104 million. The fifth-year annualized costs, including depreciation and interest, are estimated at $33 million. About a third of these costs would be incurred by mills expanding capacity, while the remainder would be incurred by mills replacing depreciated designated facilities.

The costs that new, modified, and reconstructed kraft pulp mills would incur to comply with the proposed standards are considered reasonable. No difference in impact among mill sizes could be distinguished, and the proposed standards would not have an adverse impact on either small or large mills. The capital required for typical new mills would be increased by less than 2 percent, and the price of semi-bleached kraft pulp would be increased by less than 2 percent. The effect the proposed standards would have on demand and supply of kraft pulp and on the future growth of the kraft pulp industry is considered negligible. It is emphasized that the costs are considered reasonable for new and modified sources and that it is not implied that the same costs apply to the retrofitting of existing sources. The review of the economic impact has shown that the proposal is not a major action under the Inflationary Impact Statement (IIS) program and no IIS is needed.

SELECTION OF SOURCE CATEGORY AND AFFECTED FACILITIES

Section 111 of the Act directs the Administrator to establish standards of performance for stationary sources that may contribute significantly to air pollution which causes or contributes to the endangerment of public health or welfare. Kraft pulp mills are a major source of TRS compounds and particulate matter emissions. TRS compounds can have an adverse effect on public welfare, and particulate matter can have an adverse effect on public health and welfare. Kraft pulp mills were selected for the development of standards based on expected growth of the industry and the beneficial impact that would result from the application of best technology for air pollution control. Kraft pulping has historically been a rapidly growing industry, with a growth rate of 5.5 percent per year between 1956 and 1975. The annual growth rate for 1976 to 1978 is projected to be 2.5 percent, but estimates show that the growth rate may return to a higher rate in 1979.

TRS emissions from kraft pulp mills are composed primarily of hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide. These sulfide compounds are extremely odorous and exhibit odor threshold concentrations of no more than a few parts per billion. A study of the national social and economic impacts of odors performed in 1971-1973 by Copley International Corporation for EPA found that the pulp and paper industry ranks in the upper quarter of all odor sources in terms of strength and public objection to the odors. The emissions from each pulp mill surveyed in the study affect an average of 44,000 persons over an area of approximately 100 square miles. The survey of 184 local air pollution control agencies in the United States ranked the pulp and paper source category as the fastest growing odor problem.

The establishment of standards of performance for TRS emissions from kraft pulp mills under section 111 of the Act would involve section 111(d) which provides for control of any air pollutants which are not on lists published pursuant to section 108(a) or 112(b)(1)(A) of the Act. TRS has not been named on either list. Specifically, section 111(d) requires that the Administrator prescribe a procedure to assure that States develop, implement, and enforce emission standards for existing sources that would be subject to the standard of performance if they were new sources. EPA promulgated regulations that establish procedures and requirements for submittal of State plans under section 111(d) on November 17, 1975 (40 FR 53339). As a consequence of the provisions of section 111(d), promulgation of this standard of performance for new and modified sources would require that the States develop emission standards for existing kraft pulp mills.

The proposed standards would apply to all process gas streams which have been identified as major sources of TRS compounds or particulate matter at kraft pulp mills. The following affected facilities are specified by the proposed standards: (1) Digester system, (2) brown stock washer system, (3) multiple-effect evaporator system, (4) black liquor oxidation system, (5) recovery furnace, (6) smelt dissolving tank, (7) lime kiln, and (8) condensate stripping system.

Water treatment ponds are significant sources of TRS emissions at some kraft pulp mills. Evaluations of odors in the immediate vicinity of mills indicate that TRS emissions from these ponds vary considerably from source to source, and do not produce an odor problem at some mills. Methods for measuring TRS emissions from kraft pulp mill water treatment ponds are not available at this time, and the proposed standards would not apply to these facilities. Emissions from ponds can be avoided by treating the process condensate stream in a condensate stripper system prior to discharge into the pond, but bacterial action could generate additional TRS in some ponds. EPA intends to further investigate measurement and emission control methods for water treatment ponds at kraft pulp mills, and determine whether regulation under the performance standard is appropriate.

Bark and power boilers are two sources of particulate emissions at kraft pulp mills that are not covered by the proposed standards. EPA plans to develop new source performance standards for industrial boilers, and this source category will include boilers at kraft pulp mills.

Rationale

The bases for the proposed standards include include information derived from (1) available technical literature on the kraft pulping industry and emission control of the kraft pulping process, (2) published studies sponsored by EPA of emission control of the kraft pulping process, (3) information gathered during visits to pollution control agencies and kraft pulp mills in the United States, (4) comments and suggestions solicited from experts, and (5) the results of measurements of emissions conducted by EPA and by the industry. The proposed standards for TRS emissions would require combinations of several control methods:

1. Use of improved process operating procedures to reduce the generation of TRS, such as control of the black liquor firing rate, the oxygen concentration within the furnace, and the air-to-solids ratio during operation (recovery furnace); more efficient mud washing and control of temperature and oxygen concentration (lime kiln); and use of clean water that is low in dissolved sulfides in the particulate scrubber (smelt dissolving tank).

2. Use of process equipment such as the indirect-contact evaporator system or black liquor oxidation system that inherently reduces the generation of TRS (recovery furnance system).

3. Use of control equipment such as scrubbers with caustic solution to collect TRS (lime kiln).

4. Use of incineration to convert TRS into less objectionable compounds (digester system, brown stock washer system, multiple-effect evaporator system, black liquor oxidation system, and condensate stripper system).

Recovery Furnace

The recovery furnace is the largest single source of particulate matter and TRS at a kraft pulp mill. In the direct-contact conventional furnace, heat is recovered by directly contacting the furnace combustion gases with black liquor in a direct-contact evaporator. Most of the TRS discharged from direct-contact recovery furnaces is generated in the direct-contact evaporator, which also collects an appreciable portion of the particulate matter generated by the combustion of black liquor in the furnace.

The two methods for reducing TRS emissions from recovery furnaces are: (1) The use of a black liquor oxidation system to reduce the sodium sulfide content of the black liquor before evaporation in a direct-contact evaporator, and thereby the formation of TRS in the direct-contact evaporator, and (2) the elimination of the direct-contact evaporator in an indirect-contact recovery furnace. Since comparable emission levels of TRS can be achieved by these two control methods, the proposed standards could be attained by using either type of recovery furnace. However, the proposed emission limit of 5 ppm TRS, four-hour average, is lower than that being achieved by some existing recovery furnaces of either type and would therefore require more careful operation and additional black liquor oxidation for comparable new furnaces.

Electrostatic precipitators (ESP's) are used almost universally to control particulate matter emissions from kraft recovery furnaces. Scrubbers with relatively low collection efficiencies are in use at a few facilities. Tests performed by EPA demonstrate that the proposed particulate standard would be achieved by a properly designed and well maintained ESP.

The industry has stated that ESP's operated on kraft recovery furnaces significantly deteriorate over the life of the ESP even when it is well maintained. In response, EPA obtained information from mill operators and vendors of ESP's and concluded that good maintenance of wires, collection plates, and rapping systems would ensure that particulate matter emissions from a properly designed and operated ESP would not increase to a large extent over the life of the ESP. EPA recognizes that ESP's for kraft recovery furnaces must withstand more severe service than for some other applications. Accordingly, the proposed standards would require the more ruggedly designed ESP's in order to accommodate, for example, the more severe plate rapping and stressing of wires experienced at kraft pulp mills. The additional cost of the more ruggedly designed ESP was included in the economic analysis and is considered to be reasonable.

The industry has also stated that the performance of FSP's operated on kraft recovery furnaces should be allowed to deteriorate until there is a sufficient amount of maintenance to be performed that the necessary shutdown of the furnace would be justified. EPA believes that this is a reasonable approach. Accordingly, the proposed particulate matter standard for recovery furnaces would allow some deterioration; the proposed emission limit has been set somewhat higher than the levels known to be achievable on the basis of both the results of particulate matter tests performed by EPA and design levels for new kraft recovery furnace ESP's.

EPA has determined that an oxygen concentration in excess of 8 percent in the gas stream measured after the recovery furnace control device represents excessive air inleakage and results in excessive dilution of the gas stream. The proposed standard, therefore, requires that all concentrations of particulate matter and TRS measured after the recovery furnace control device that have an oxygen concentration in excess of 8 percent be corrected to 8 percent oxygen.

Lime Kiln

Lime kilns are a major source of particulate matter emissions at kraft pulp mills. Because the lime mud that is processed in the kiln contains residual quantities of sulfides, lime kilns are also sources of TRS emissions.

The two methods for controlling TRS emissions from lime kilns are: (1) more efficient washing to reduce the sulfide content of the lime mud, and control of kiln exhaust gas temperature and oxygen content, and (2) use of sodium hydroxide (caustic) in the scrubber that controls particulate emissions from most kilns. Tests carried out by EPA demonstrate that when the first TRS control method (process control) is applied, the simultaneous addition of caustic to a scrubber produces a significant reduction in TRS emissions below that achievable with process control alone. The annualized cost for caustic addition to the scrubber is small where the caustic is not part of the make-up in the kraft causticizing system. Accordingly, the proposed standard of 5 ppm TRS, four-hour average, would require both the best process controls for lime kiln operation and caustic addition to the scrubber, or an equivalent system.

In developing the proposed standards, EPA carried out six tests for particulate emissions from lime kilns. In each case the control device for particulate matter was a medium pressure drop scrubber, the most widely used control technique in the domestic industry. However, one domestic kraft pulp mill controls particulate emissions with an electrostatic precipitator. Based on design parameters and emission data supplied by the operator of this ESP, this system achieves an emission level significantly below that determined by EPA for medium pressure drop scrubbers. However, the waste gases from the digester system and multiple-effect evaporator system, which could more economically be incinerated in the lime kiln, are processed in a separate incinerator at this facility to control TRS emissions. The cost and energy penalties for the separate incinerator are relatively large. The industry has commented that it may not be feasible to incinerate the waste gases from other sources in a kiln controlled by an ESP, because gases may explode in the ESP when flameouts occur in the kiln. Solutions to this potential problem, such as automatic diverting of inlet gases away from the kiln when a flameout occurs, have been considered, but there is at this time no demonstrated technology that will ensure that explosions would not occur.

In arriving at the proposed standard for particulate matter emissions from lime kilns, EPA considered the alternatives of a medium pressure drop scrubber alone, an ESP alone, and both particulate control systems operated in series. A separate incinerator to control TRS emissions from digester systems, multiple-effect evaporator systems, and condensate stripper systems was included in the two alternative ESP systems. EPA concluded that the relatively large increments in cost and energy usage associated with the ESP alternatives were not justified by the additional particulate control gained beyond that achievable with a medium pressure drop scrubber alone. Consequently, the proposed particulate matter standard would require a medium pressure drop scrubber (approximately 30 inches water gauge), or equivalent.

EPA has determined that an oxygen concentration in the gas stream measured after the lime kiln control device in excess of 10 percent represents excessive air inleakage; therefore, the proposed standards require that all measurements of particulate matter and TRS that have an oxygen concentration in excess of 10 percent be corrected to 10 percent oxygen.

SMELT DISSOLVING TANK

Smelt dissolving tanks discharge particulate matter comprised of finely divided smelt particles that are entrained in the steam emitted from the tank. On an uncontrolled basis, the quantity of particulate emissions is small in comparison with that from recovery furnaces and lime kilns. TRS emissions can be generated in the dissolving tank or in a scrubbing device that collects particulate matter, depending primarily on the sulfide content of water used to dissolve the smelt and to perform the scrubbing. Standards in terms of concentration of pollutants are not considered appropriate for smelt dissolving tanks because the effluent stream is primarily air and no correction for oxygen content and dilution air is possible to ensure effective enforcement.

Particulate emissions from smelt dissolving tanks are controlled by using wire mesh demister pads or low energy scrubbers. The scrubbers remove particulate matter much more effectively, though the energy requirements and operating costs are higher than for demisters. The proposed particulate standard for smelt dissolving tanks would require the use of low energy scrubbers, or equivalent systems, and is supported by four EPA tests on two types of low energy scrubbers. The proposed TRS standard for smelt dissolving tanks would prevent the use of water highly contaminated with sulfides for dissolving the smelt and for particulate scrubbing systems.

OTHER SOURCES

Approximately one-quarter of the total uncontrolled TRS emissions from a typical kraft pulp mill are generated by the digester system, brown stock washer system, black liquor oxidation system, multiple-effect evaporator system, and condensate stripper system. Ineffective control of these facilities could have a large impact on localized odor problems. The effluent streams can be incinerated in the recovery furnace, the lime kiln, or a separate incinerator to oxidize most of the TRS. The quantity of auxiliary fuel required for incineration is greatly reduced if incineration is performed in the recovery furnace and the lime kiln. If the noncondensable gases from the brown stock washer system and the black liquor oxidation system are incinerated, for example, in the recovery furnace, some auxiliary fuel may be required. However, the noncondensable gases from the digester system, multiple-effect evaporator system, and condensate stripper system would not require additional fuel if incinerated in the lime kiln as part of the primary air feed to the kiln. The proposed standard of 5 ppm TRS, four-hour average, for each of these five affected facilities would require incineration in the recovery furnace and the lime kiln, or equivalent.

OPACITY STANDARD

An opacity standard is proposed for recovery furnace systems to ensure proper operation and maintenance of the particiulate control device. No opacity standards are proposed for lime kilns and smelt dissolving tanks, which frequently generate persistent plumes of condensed water vapor. The effluent plume is so greatly dispersed by the time the vapor plume disappears that the observed opacity would not be as effective an indicator of the performance of the patriculate control system as other parameters. Monitoring the operating parameters of the control system would be more effective.

STATE IMPLEMENTATION PLANS

It should be noted that standards of performance for new sources established under section 111 of the Clean Air Act reflect emission limits achievable with the best adequately demonstrated systems of emission reduction considering the cost of such systems. State implementation plans (SIP's) approved or promulgated under section 110 of the Act on the other hand, must provide for the attainment and maintenance of national ambient air quality standards (NAAQS) designed to protect public health and welfare. For that purpose SIP's must in some cases require greater emission reductions than those required by standards of performance for new sources. In addition, States are free under section 116 of the Act to establish more stringent emission limits than those established under section 111 or those necessary to attain or maintain the NAAQS under section 110. Thus, new and existing sources may in some cases be subject to limitations more stringent than EPA's standards of performance under section 111.

TESTING, MONITORING, AND RECORDKEEPING

Under the proposed standards, performance tests for TRS emissions according to Reference Method 16 proposed herein would be required for all affected facilities. Performance tests for particulate matter emissions from recovery furnace systems, lime kilns, and smelt dissolving tanks would also be required. Particulate matter emissions would be measured by Reference Methods 1 through 5. Method 17 (in-stack filter) is being proposed as an alternative method to measure particulate emissions from the recovery furnace. It is being proposed in Appendix A, Reference Methods, because the Agency intends to also propose Method 17 as a reference method to measure particulate matter from grain elevators.

The proposed standards include provisions for continuously monitoring the opacity of visible emissions discharged from recovery furnaces. To ensure proper operation and maintenance of scrubbers installed on lime kilns and on smelt dissolving tanks, provisions are included for monitoring the pressure drop across the scrubber and the scrubbing fluid supply pressure to the scrubber.

Where emissions from the digester system, brown stock washer system, multiple-effect evaporator system, black liquor oxidation system, or condensate stripper are incinerated in a device other than a lime kiln or recovery furnace, it is proposed that the firebox temperature of the device be monitored.

A requirement for the continuous monitoring of TRS emissions from the recovery furnace and lime kiln is also proposed. The specifications for continuous TRS monitors are not being proposed at this time because they have not been completely developed. However, the development of these specifications are imminent and they are expected to be promulgated at the time that the kraft pulp mill standards of performance are promulgated.

A requirement to monitor the oxygen concentration of the gas stream on a dry basis after the control device is being proposed for the lime kiln and recovery furnace. The montoring of oxygen concentrations is necessary to correct the TRC and particulate concentrations for the lime kiln and recovery furnace when the oxygen concentrations in the respective gas streams are in excess of 10 percent and 8 percent oxygen.

Records of performance testing measurements, continuous monitoring system measurements, and monitoring device measurement would have to be retained for at least two years following the date of the measurements by owners or operators subject to the provisions of this subpart. This requirement is included under § 60.7(d) of the regulation.

PUBLIC PARTICIPATION

As prescribed by section 111, this proposal of standards of performance has been preceded by the Administrator's determination that kraft pulp mills contribute significantly to air pollution which causes or contributes to the endangerment of public health or welfare and by his publication of this determination in this issue of the FEDERAL REGISTER. In accordance with section 117 of the Act, publication of these proposed standards was preceded by consultation with appropriate advisory committees, independent experts, and Federal departments and agencies.

Interested persons may participate in this rulemaking by submitting written comments (in triplicate) to the Emission Standards and Engineering Division, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, Attention: Mr. Don R. Goodwin. The Administrator will welcome comments on all aspects of the proposed regulations, including the designation of kraft pulp mills as a significant contributor to air pollution which causes or contributes to the endangerment of public health or welfare, economic and technological issues, and the proposed test methods. All relevant comments received on or before November 22, 1976 will be considered. Comments received will be available for public inspection and copying at the EPA Public Information Reference Unit, Room 2922 (EPA Library), 401 M Street, S.W., Washington, D.C. 20460.

Background information on these proposed standards of performance has been published in a document entitled "Standards Support and Environmental Impact Statement: Standards of Performance for Kraft Pulp Mills, Volume 1." This report presents the factors considered in the development of the proposed standards, including alternative emission control systems, emission test data, environmental impact, costs, and economic considerations. Copies of the document may be obtained free of charge by writing to the Public Information Center (PM-215), U.S. Environmental Protection Agency, Washington, D.C. 20460 (specify "Standards Support and Environmental Impact Statement: Standards of Performance for Kraft Pulp Mills, Volume 1").

AUTHORITY: This notice of proposed rulemaking is issued under the authority of secs. 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 1857c-6, 1857c-9, 1857g(a))

Dated: September 16, 1976.

OHN QUARLES,
Ac[illegible] Administrator.

It is proposed to amend Part 60 of Chapter I of Title 40 of the Code of Federal Regulations as follows:

1. By adding subpart BB as follows:

Subpart BB—Standards of Performance for Kraft Pulp Mills

Sec.
60.280 Applicability and designation of affected facility.
60.281 Definitions.
60.282 Standard for particulate matter.
60.283 Standard for total reduced sulfur (TRS).
60.284 Monitoring of emissions and operations.
60.285 Test methods and procedures.

AUTHORITY: Secs. 111, 114, and 301(a) of the Clean Air Act, as amended by sec. 4(a) of Pub. L. 91-604, 84 Stat. 1678 and by sec. 15(c)(2) of Pub. L. 91-604, 84 Stat. 1713 (42 U.S.C. 1857c-6, 1857c-9, and 1857g(a)).

Subpart BB—Standards of Performance for Kraft Pulp Mills

§ 60.280 Applicability and designation of affected facility.

The provisions of this subpart are applicable to the following affected facilities in kraft pulp mills: digester system, brown stock washer system, multiple-effect evaporator system, black liquor oxidation system, recovery furnace, smelt dissolving tank, lime kiln, and condensate stripper system. In pulp mills in which kraft pulping is combined with neutral sulfide semichemical pulping, the provisions of this subpart are applicable when any portion of the material charged to an affected facility is produced by the kraft pulping operation.

§ 60.281 Definitions.

As used in this subpart, all terms not defined herein shall have the same meaning given them in the Act and in Subpart A.

(a) "Kraft pulp mill" means any stationary source which produces pulp from wood by cooking (digesting) wood chips in a water solution of sodium hydroxide and sodium sulfide (white liquor) at high temperature and pressure. Regeneration of the cooking chemicals through a recovery process is also considered part of the kraft pulp mill.

(b) "Neutral sulfite semichemical pulping operation" means any operation in which pulp is produced from wood by cooking (digesting) wood chips in a solution of sodium sulfite and sodium bicarbonate, followed by mechanical defibrating (grinding).

(c) "Total reduced sulfur (TRS)" means the sum of the sulfur compounds, primarily hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide, that are released during the kraft pulping operation and measured by Method 16.

(d) "Digester system" means each continuous digester or each batch digester used for the cooking of wood in white liquor, and associated flash tank(s), blow tank(s), chip steamer(s), and condenser(s).

(e) "Brown stock washer system" means knotters, vacuum pumps, and filtrate tanks used to wash the pulp following the digester system.

(f) "Multiple-effect evaporator system" means the multiple-effect evaporators and associated condenser(s) and hotwell(s) used to concentrate the spent cooking liquid that is separated from the pulp (black liquor).

(g) "Black liquor oxidation system" means the vessels used to oxidize, with air or oxygen, the black liquor, and associated storage tank(s).

(h) "Recovery furnace" means the unit used for burning black liquor to recover chemicals consisting primarily of sodium carbonate and sodium sulfide. The recovery furnance includes the direct-contact evaporator for a conventional furnace.

(i) "Smelt dissolving tank" means a vessel used for dissolving the smelt collected from the recovery furnace.

(j) "Lime kiln" means a unit used to calcine lime mud, which consists primarily of calcium carbonate, into quicklime, which is calcium oxide.

(k) "Condensate stripper system" means a column, and associated condensers, used to strip, with air or steam, TRS compounds from condensate streams from various processes within a kraft pulp mill.

§ 60.282 Standard for particulate matter.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere:

(1) From any recovery furnace any gases which:

(i) Contain particulate matter in excess of 0.10 g/dscm (0.044 gr/dscf).

(ii) Exhibit 35 percent opacity or greater.

(2) From any smelt dissolving tank any gases which contain particulate matter in excess of 0.15 g/Kg ADP (0.3 lb/ton ADP).

(3) From any lime kiln any gases which:

(i) Contain particulate matter in excess of 0.15 g/dscm (0.067 gr/dscf) when gaseous fossil fuel is burned.

(ii) Contain particulate matter in excess of 0.30 g/dscm (0.13 gr/dscf) when liquid fossil fuel is burned.

§ 60.283 Standard for total reduced sulfur (TRS).

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere:

(1) From any digester system, brown stock washer system, multiple-effect evaporator system, black liquor oxidation system, or condensate stripper system any gases which contain TRS in excess of 5 parts per million (ppm) by volume, except as provided under paragraph (b) of this section.

(2) From any recovery furnace any gases which contain TRS in excess of 5 ppm by volume.

(3) From any smelt dissolving tank any gases which contain TRS in excess of 0.025 g/Kg ADP (0.0125 lb/ton ADP).

(4) From any lime kiln any gases which contain TRS in excess of 5 ppm by volume.

(b) The Administrator may exempt any new, modified, or reconstructed black liquor oxidation system or brown stock washer system at an existing kraft pulp mill provided the owner or operator demonstrates that incinerating the exhaust gases from such system in an existing recovery furnace is technologically and economically not feasible. Any exempt system will become subject to the provisions of this subpart if the recovery furnace is changed so that the gases can be incinerated.

§ 60.284 Monitoring of emissions and operations.

(a) Any owner or operator subject to the provisions of this subpart shall install, calibrate, maintain, and operate the following continuous monitoring systems:

(1) A continuous monitoring system to monitor and record the opacity of the gases discharged into the atmosphere from any recovery furnace. The span of this system shall be set at 50 percent opacity.

(2) A continuous monitoring system, except as provided in paragraph (b)(1) of this section, to monitor and record the concentration of TRS emissions discharged into the atmosphere from any digester system, brown stock washer system, multiple-effect evaporator system, black liquor oxidation system, recovery furnace, lime kiln, or condensate stripper system. The span shall be set at a TRS concentration of 30 ppm.

(3) A continuous monitoring system to monitor and record the percent of oxygen by volume in the gases discharged from any recovery furnace or lime kiln. The continuous monitoring system shall be located downstream of the control device(s) for the recovery furnace or lime kiln, and all measurements shall be made on a dry basis. The span of this system shall be set at 20 percent oxygen.

(b) Any owner or operator subject to the provisions of this subpart shall install, calibrate, maintain, and operate the following continuous monitoring devices:

(1) A monitoring device which measures the combustion temperature at the point of incineration of effluent gases which are emitted from any digester system, brown stock washer system, multiple-effect evaporator system, black liquor oxidation system, or condensate stripper system and which are combusted in a power boiler or separate incineration unit. The monitoring device is to be certified by the manufacturer to be accurate within ±2° C (±3.6° F).

(2) For any lime kiln or smelt dissolving tank using a scrubber emission control device:

(i) A monitoring device for the continuous measurement of the pressure loss of the gas stream through the control equipment. The monitoring device is to be certified by the manufacturer to be accurate to within a gage pressure of ±250 pascals (ca. ±1 inch water gage pressure).

(ii) A monitoring device for the continuous measurement of the scrubbing liquid supply pressure to the control equipment. The monitoring device is to be certified by the manufacturer to be accurate within ±5 percent of design scrubbing liquid supply pressure. The pressure sensor or tap is to be located close to the scrubber liquid discharge point. The Administrator may be consulted for approval of alternative locations.

(c) Any owner or operator subject to the provisions of this subpart shall calculate and record on a daily basis:

(1) Four-hour average TRS concentrations for the six consecutive four-hour periods of each operating day. Each four-hour average shall be determined as the arithmetic mean of the appropriate four contiguous one-hour average total reduced sulfur concentrations provided by each continuous monitoring system installed under paragraph (a)(2) of this section.

(2) Four-hour average oxygen concentrations for the six consecutive four-hour periods of each operating day for the recovery furnace and lime kiln. These four-hour averages shall correspond to the four-hour average TRS concentrations under paragraph (c)(1) of this section and shall be determined as an arithmetic mean of the appropriate four contiguous one-hour average oxygen concentrations provided by each continuous monitoring system installed under paragraph (a)(3) of this section.

(d) Any owner or operator of a recovery furnace or lime kiln subject to the provisions of this subpart shall:

(1) Correct any four-hour average TRS concentration corresponding to a four-hour average oxygen concentration that is in excess of 8 volume percent for the recovery furnace. The concentration shall be corrected to 8 volume percent oxygen.

(2) Correct any four-hour average TRS concentration corresponding to a four-hour average oxygen concentration that is in excess of 10 volume percent for the lime kiln. The concentration shall be corrected to 10 volume percent oxygen.

(3) Calculate the corrections required in paragraphs (d) (1) and (2) of this section according to the following equation:

$$C_{corr} = C_{meas} \times \left(\frac{21-X}{21-Y}\right)$$

where

C_{corr} = the four-hour TRS concentration corrected for oxygen.

C_{meas} = the four-hour average measured TRS concentration uncorrected for oxygen.

X = the volumetric oxygen concentration in percentage to be corrected to (8 percent for the recovery furnace and 10 percent for the lime kiln).

Y = the measured four-hour average volumetric oxygen concentration above 8 volume percent for the recovery furnance and above 10 volume percent for the lime kiln.

(e) For the purpose of reports required under § 60.7(c), any owner or operator subject to the provisions of this subpart shall report periods of excess emissions as follows:

(1) For emissions from the recovery furnace:

(i) All four-hour averages of TRS concentrations above 5 ppm.

(ii) All six-minute average opacities that exceed 35 percent, except that 5 percent of the averages may exceed 35 percent opacity. The exception does not apply to excess emissions due to malfunctions, startups, or shutdowns of the facility or control device.

(2) For emissions from the lime kiln: All four-hour average TRS concentrations above 5 ppm, except that 6 percent of all four-hour averages of TRS concentrations are not considered to be excess emissions if they are less than 10 ppm. The exception does not apply to excess emissions due to malfunctions, startups, or shutdowns of the facility or control device.

(3) For emissions from the digester system, brown stock washer system, multiple-effect evaporator system, black liquor oxidation system, or condensate stripper system where the gases are incinerated in a device other than a recovery furnace or lime kiln: All four-hour average TRS concentrations above 5 ppm, unless the requirements of paragraph (b)(1) of this section are met.

§ 60.285 Test methods and procedures.

(a) Reference methods in Appendix A of this part, except as provided under § 60.8(b), shall be used to determine compliance with § 60.282(a) as follows:

(1) Method 5 for the concentration of particulate matter and the associated moisture content,

(2) Method 1 for sample and velocity traverses,

(3) When determining compliance with § 60.282(a)(2), Method 2 for velocity and volumetric flow rate,

( ) Method 3 for gas analysis, and

( ) Method 9 for visible emissions.

(b) For Method 5, the sampling time for each run shall be at least 60 minutes and the sampling rate shall be at least .85 dscm/hr (0.53 dscf/min) except that shorter sampling times, when necessitated by process variables or other factors, may be approved by the Administrator. Water shall be used as the cleanup solvent instead of acetone in the sample recovery procedure outlined in Method 5.

(c) Method 17 (in-stack filtration) may be used as an alternate method for Method 5 for determining compliance with § 60.282(a)(1)(i): *Provided*, That a constant value of 0.009 g/dscm (0.004 gr/dscf) is added to the results of Method 17 and the stack temperature is no greater than 205° C (ca. 400° F). Water shall be used as the cleanup solvent instead of acetone in the sample recovery procedure outlined in Method 17.

(d) For the purpose of determining compliance with § 60.283(a) (1), (2), (3), and (4), the following reference methods shall be used:

(1) Method 16 for the concentration of TRS,

(2) Method 3 for gas analysis, and

(3) When determining compliance with § 60.283(a)(3), Method 2 for velocity and volumetric flow rate.

(e) All concentrations of particulate matter and TRS from the lime kiln and recovery furnace that are measured as required by this section shall be corrected to 10 volume percent oxygen and 8 volume percent oxygen, respectively, when the oxygen concentrations exceed these values.

APPENDIX A—REFERENCE METHODS

2. Method 16 and Method 17 are added to Appendix A as follows:

* * * * *

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 60]

[FRL 635-4]

KRAFT PULP MILLS

Standards of Performance for New Stationary Sources; Correction

In FR Doc. 76-27786 appearing at page 42012 in the FEDERAL REGISTER of September 24, 1976, the following changes should be made:

1. On page 42012, paragraph 3, line 10 is corrected to read as follows: "0.0125 g/Kg ADP is proposed for smelt."

2. On page 42016, § 60.283(a)(3) is corrected to read as follows:

§ 60.283 Standard for total reduced sulfur (TRS).

* * * * *

(a) * * *

(3) From any smelt dissolving tank any gases which contain TRS in excess of 0.0125 g/Kg ADP (0.025 lb/ton ADP).

3. On page 42020, Equation 16-2 is corrected to read as follows:

$$TRS=\Sigma(H_2S,\ MeSH,\ DMS,\ 2DMDS,\ x)d$$

4. On page 42027, Equation 17-7 is corrected to read as follows:

$$I=\frac{100\ T_s[KV_{lc}+(Vm/Tm)\ (P_{bar}+\Delta H/13.6)]}{60\ \theta v_s P_s A_n}$$

Dated: October 21, 1976.

EDWARD F. TUERK,
Acting Assistant Administrator for Air and Waste Management.

[FR Doc.76-31583 Filed 10-28-76;8:45 am]

FEDERAL REGISTER, VOL. 41, NO. 210—FRIDAY, OCTOBER 29, 1976

[40 CFR Part 60]

[FRL 648-8]

KRAFT PULP MILLS

Standards of Performance for New Stationary Sources; Extension of Comment Period

On September 24, 1976 (41 FR 42012), the Environmental Protection Agency (EPA) proposed standards of performance for the control of emissions from kraft pulp mills. The notice of proposal requested public comments on the standards by November 22, 1976. Due to a delay in the printing and shipping of the Standards Support and Environmental Impact Statement, sufficient copies of the document have not been available to all interested parties in time to allow their meaningful review and comment by November 22. The public comment period is therefore being extended to allow additional time for all interested parties to participate in this rulemaking. EPA has received a request from the industry to extend the comment period by 45 days through January 7, 1977. An extension of this length does not, however, seem justified because the printing and shipping delay has resulted in only a two-week delay in processing requests for the document. EPA has therefore determined that the comment period will be extended by three weeks and all comments postmarked by December 13, 1976, will be considered. Comments should be submitted (in triplicate) to the Emission Standards and Engineering Division (MD-13), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, Attention: Mr. Don R. Goodwin.

Dated: November 19, 1976.

ROGER STRELOW,
Assistant Administrator for Air and Waste Management.

[FR Doc.76-34661 Filed 11-22-76;8:45 am]

FEDERAL REGISTER, VOL. 41, NO. 227—TUESDAY, NOVEMBER 23, 1976

ENVIRONMENTAL PROTECTION AGENCY

■

LIME MANUFACTURING PLANTS

Standards of Performance and Addition to List of Categories of Stationary Sources

SUBPART HH

Reproduced from
best available copy.

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 60]

[FRL 704-1]

STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

Lime Manufacturing Plants

AGENCY: Environmental Protection Agency.

ACTION: Proposed rule.

SUMMARY The proposed standards would limit emissions of particulate matter from new, modified, and reconstructed lime manufacturing plants. The standards implement the Clean Air Act and are based on the Administrator's determination that lime manufacturing plant emissions contribute significantly to air pollution. The intended effect is to require new, modified, and reconstructed lime manufacturing plants to use the best demonstrated system of emission reduction.

DATES: Comments must be received on or before July 5, 1977.

ADDRESS: Comments should be submitted, preferably in triplicate, to the Emission Standards and Engineering Division, Environmental Protection Agency, Research Triangle Park, North Carolina 27711, Attention: Mr. Don R. Goodwin.

The Standards Support and Environmental Impact Statement (SSEIS) may be obtained from the Public Information Center (PM-215), U.S. Environmental Protection Agency, Washington, D.C. 20460 (specify "Standards Support and Environmental Impact Statement, Volume 1: Proposed Standards of Performance for Lime Manufacturing Plants").

All public comments received will be available for inspection and copying during normal business hours at EPA's Public Information Reference Unit, Room 2922 (EPA Library), 401 M Street SW., Washington, D.C.

FOR FURTHER INFORMATION CONTACT:

Don R. Goodwin, Emission Standards and Engineering Division, Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone number 919-688-8146, extension 271.

SUPPLEMENTARY INFORMATION:

SUMMARY OF ENVIRONMENTAL AND ECONOMIC IMPACTS

The proposed standards could impact an estimated 6.8 teragrams (7.5 million tons) of lime manufacturing capacity by 1982. About one-third of that would be due to replacement of existing facilities and the remainder due to installation of equipment needed for expansion of industry capacity. EPA estimates that approximately 8 to 10 new rotary lime kilns and one new lime hydrator will be built each year for the next five years.

The proposed standards would reduce national particulate emissions from lime manufacturing plants by about 13 gigagrams (about 14,200 tons) through 1982. This reduction would be accomplished with only minimal adverse environmental impacts on water pollution and solid waste handling and disposal. National energy consumption would be decreased slightly by the equivalent of nine cubic meters or about 55 barrels of No. 6 fuel oil per day in 1982.

Total incremental investment costs through 1982 to meet the proposed standards are projected to be about $3 million. The annualized costs in 1982, including depreciation and interest, are estimated to be about $5 million. The potential price increase that would result from implementation of the proposed standards for new or reconstructed kilns has been estimated to be about 80 cents per megagram of lime produced, or an increase of approximately 2.6 percent. The costs for control of particulate emissions from the affected facilities are considered reasonable.

The proposed particulate standard for rotary lime kilns is based on the use of a baghouse or an electrostatic precipitator. Use of either of these systems would result in minimal adverse environmental impacts. A venturi scrubber could also be used to meet the standards. Although venturi scrubbers would result in an additional beneficial environmental impact by reducing SO_2 emissions by about 7 percent, they would also result in adverse impacts on solid waste disposal, water pollution, and energy consumption.

The proposed particulate standard for lime hydrators is based on the use of a scrubber. Since the typical State standard for this facility also requires the use of a scrubber, there would be minimal environmental impacts associated with the proposed standard. The incremental energy required is small, an increase of less than one percent. All of the collected particulate matter could be recycled to the unit along with the scrubbing water. Therefore, there would be no adverse environmental impacts on solid waste disposal or water pollution.

RATIONALE FOR THE PROPOSED STANDARDS

The proposed standards would require the best demonstrated technology, considering costs, for the control of particulate matter emissions be installed and properly operated at new, modified, and reconstructed lime manufacturing plants. The proposed standards were developed based on information derived from (1) available technical literature on the lime manufacturing industry and applicable emission control technology, (2) technical studies performed for EPA by independent research organizations, (3) information obtained from the industry during visits to lime plants and meetings with various representatives of the industry, (4) comments and suggestions solicited from experts, and (5) the results of emission measurements conducted by EPA and the industry.

It should be noted that standards of performance for new sources established under section 111 of the Clean Air Act reflect emission limits achievable with the best demonstrated systems of emission reduction considering the cost of such systems. State implementation plans (SIP's) approved or promulgated under section 110 of the Act, on the other hand, must provide for the attainment and maintenance of national ambient air quality standards (NAAQS) designed to protect public health and welfare. For that purpose SIP's must in some cases require greater emission reductions than those required by standards of performance for new sources. For example, EPA's Interpretative Ruling (41 FR 55524, December 21, 1976) on the construction of a new or modified source in an area that exceeds a NAAQS requires, among other things, that the new source must meet an emission limitation which reflects the "lowest achievable emission rate" for such type of source. At a minimum, the lowest rate achieved in practice would have to be specified unless the applicant can demonstrate that it cannot achieve such a rate. In no event could the rate exceed any applicable standard of performance for new sources.

This stringent requirement reflects EPA's judgment that a new source should be allowed to emit pollutants into an area violating a NAAQS only if its contribution to the violation is reduced to the greatest degree possible. While cost of achievement may be an important factor in determining a standard of performance for new sources applicable to all areas of the country (clean as well as dirty) as a minimum, the cost factor must be accorded far less weight in determining an appropriate emission limitation for a source locating in an area violating statutorily-mandated health and welfare standards. Thus, while there may be technology available for new sources which have been determined not to be appropriate for standards of performance purposes, because of the greater consideration of the cost factor, this technology still should be considered for purposes of determining the "lowest achievable emission rate" for such type of sources. The existence of a standard of performance for new sources should not be viewed as the ultimate in achievable control and should not limit the imposition of a more stringent standard, where appropriate.

In addition, States are free under section 116 of the Act to establish even more stringent emission limits than those established under section 111 or those necessary to attain or maintain the NAAQS under section 110, including the emission offset policy requirements outlined here. Thus, new sources may in some cases be subject to limitations more stringent than EPA's standards of performance under section 111, and prospective owners and operators of new sources should be aware of this possibility in planning for such facilities.

Selection of the Source Category, Pollutants, and Affected Facilities. Section 111 of the Act directs the Administrator to establish standards of performance for new and modified stationary sources that may contribute significantly to air pollution which causes or contributes to the endangerment of public health or welfare. Lime manufacturing plants have been shown to be a significant source of particulate matter emissions. A study performed for EPA in 1975 by The Research Corporation of New England ranked the lime industry twenty-fifth on a list of 112 stationary source categories which are emitters of particulate matter. Lime plants have also been identified as sources that are capable of contributing to the deterioration of existing air quality (39 FR 42510).

Lime plants have been selected for the development of standards of performance based on the expected growth rate of the industry, the wide range of plant locations across the United States, and the reduction in particulate emissions achievable with application of the best technology for emission control, considering costs. Since 1930, the demond for lime products has been increasing at a growth rate of about five percent per year. This rate is projected to continue through 1982. In 1975, there were 179 lime plants located in 40 states in the United States, producing a total of about 20 teragrams (22 million tons) of lime per year.

Lime plants are sources of emissions of particulate matter, nitrogen oxides (NO_x), carbon monoxide (CO), and sulfur dioxide (SO_2). For the reasons discussed below, at this time standards are proposed only for the control of particulate matter emissions.

NO_x emissions from lime kilns are generally emitted in low concentrations of about 200 ppm. NO_x emission reductions achievable through combustion modification or other control techniques have not been clearly identified for lime kilns. Standards of performance to reduce these emissions are therefore not being proposed.

CO emissions from lime plants are normally in concentrations of about 100 ppm. Emissions of this magnitude would result in an ambient air concentration of less than one percent of the primary ambient air quality standard under adverse meteorological conditions. The most effective control method for CO, incineration of the off-gasses, would create a severe fuel penalty, while producing very little environmental benefit. Consequently, standards of performance for control of CO emissions from lime kilns are not being proposed.

SO_2 emissions from lime kilns are due primarily to the presence of sulfur in the fuel used to fire the kiln. Potential emissions of SO_2 from a 907 Mg (1000 ton) per day lime kiln firing a coal of about 3 percent sulfur would amount to about 285 kg (650 pounds) per hour. Due to the reaction between the lime dust and the SO_2, however, a significant reduction in SO_2 emissions results. When dry particulate control, such as a baghouse or an ESP, is used, SO_2 emissions are reduced by about 85–90 percent. This SO_2 reduction can be increased to about 95 percent if a venturi scrubber is used for particulate control. These efficiencies are based on the results of EPA source tests performed on rotary kilns at several lime manufacturing plants.

Consideration of the potential environmental, economic and energy impacts, however, has convinced EPA to not propose an SO_2 standard which would force the use of venturi scrubbers. First, scrubbers use about six times more energy than do baghouses. (It should be noted, however, that despite the fact that this leads to SO_2 emissions from the power plant used to produce this energy, a net reduction in SO_2 emissions is achieved.)

Second, although scrubbers achieve lower actual SO_2 emissions than baghouses, concentrations of SO_2 in the ambient air may generally not be any lower. This is because the temperature of the stack gases from a scrubber is lower than that from a baghouse resulting in less efficient dispersion of the emissions.

Third, the annual operating costs associated with the use of a scrubber for particulate and SO_2 control is more than twice the costs of using a dry control system such as a baghouse. These costs are directly attributable to the increased power requirements of a scrubber. The beneficial impact of reducing SO_2 emissions that is achieved by using a scrubber, therefore, is attained at a relatively large economic impact.

This economic impact and the associated adverse environmental impact on water pollution, solid waste disposal and increased energy consumption are not considered reasonable in light of the relatively small beneficial impact on air quality. The Administrator has determined, therefore, that a standard of performance for control of SO_2 from lime kilns is not justified and an SO_2 standard is not being proposed.

Particulate matter is emitted from both the lime kiln and the lime hydrator. Potential particulate emissions from uncontrolled facilities would amount to about 15 kilograms per megagram (kg/Mg) of limestone feed from the kiln and about 20 kg/Mg of lime feed from the hydrator. The average State emission limit for both kilns and hydrators is 0.5 kg/Mg of feed. Through application of the best demonstrated emission control technology, the emissions from these facilities could be further reduced to 0.15 kg/Mg from the kiln and 0.075 kg/Mg from the hydrator. These emission rates represent incremental reductions in particulate emissions from rotary lime kilns and lime hydrators controlled to comply with the average State standard of 70 and 85 percent, respectively.

Lime kilns and hydrators account for virtually all of the particulate matter emitted from lime plants. Small amounts of fugitive particulate emissions may occur from various points in the process, but these have not been quantified and applicable control technology has not been investigated. No standards for control of fugitive emissions, therefore, are being proposed.

Rotary Lime Kilns. The lime kiln is the largest source of particulate emissions at a lime manufacturing plant. Although there are several types of kilns in use by the industry, the proposed standards would apply only to rotary kilns. Approximately 90 percent of the lime produced in the U.S. is produced in rotary kilns, and virtually all the new kilns that have been built in the last few years have been of the rotary type. The rotary kiln is the only kiln that can utilize coal for fuel and still maintain acceptable product quality. Since the lime manufacturing industry desires the capability in the future to burn coal, the present trend is to build and operate rotary kilns whenever possible.

The format of the proposed particulate standard for the kiln could be either a concentration standard or a mass-per-unit-of-limestone standard. Concentration standards are normally easier to enforce than mass standards. A concentration standard, however, would penalize the more energy efficient kiln operations. Since reduced fuel consumption results in smaller exhaust gas volumes, a concentration standard would require the most energy efficient kiln operators to achieve a higher degree of control.

The major problem usually associated with mass-per-unit-of-feed standards is determining the feed rate. The feed rate of the limestone into the kiln, however, is measured routinely at lime plants, thereby allowing the emission rate to be calculated directly. Since the mass-per-unit-of-limestone feed format is more equitable for the energy efficient lime producers, this format is used for the proposed standard.

EPA considers the following three devices to be representative of the best systems of emission reduction, considering costs, for particulate matter: (1) fabric filters, (2) electrostatic precipitators (ESP), and (3) venturi scrubbers.

Source tests were conducted on three baghouses, two ESP's and one scrubber. Particulate emissions from the test runs on the lime kilns controlled by baghouses or ESP's ranged from 0.016 to 0.290 kg/Mg of feed (0.033 to 0.580 lb/ton), and averaged 0.10 kg/Mg (0.20 lb/ton). One out of the three baghouses tested did not meet the level of the proposed standard. All three baghouses tested were operating under essentially the same conditions. However, for reasons explained in detail in the SSEIS, it is EPA's judgment that the baghouse that did not meet the level of the proposed standard does not represent the best control technology and the data obtained from that facility are not used in the selection of the proposed standard.

EPA also tested one scrubber for particulate emissions and found an emission rate of about 0.22 kg/Mg at a pressure drop of about 3.7 kilopascals (15 inches w.c.). This scrubber, however, is not considered to represent best technology. As explained in the SSEIS, a venturi scrubber with a higher pressure drop of about 5.4 kilopascals (22 inches w.c.) would meet the level of the proposed standard in EPA's judgment.

The results of the source tests on the four rotary lime kilns that were considered to represent the best control technology (two baghouses and two ESP's) support a particulate standard of 0.15 kg/Mg (0.3 lb/ton). A standard of 0.15 kilogram of particulate matter per megagram of limestone feed, therefore, is being proposed for rotary lime kilns.

Visible emissions data were gathered during particulate tests at six lime plants. All of the 1056 six-minute average opacity values were obtained as specified in EPA Reference Method 9. An analysis of the distribution of the data shows that over two-thirds of the six-minute averages were equal to zero percent opacity and over 99 percent of the readings fall between zero and 10 percent opacity. Based on these data, the proposed standard would limit visible emissions to 10 percent opacity. This would insure that the best system of emission reduction, installed to comply with the particulate standard, is properly operated and maintained.

When a scrubber is used for control of the particulate emissions, it is very difficult to accurately read visible emissions because of the steam plume that is present. Due to enforcement difficulties, an opacity standard would not be effective in this case, and EPA is therefore excluding rotary lime kilns controlled with scrubbers from the proposed opacity standard.

Lime Hydrators. Lime hydrators are also significant sources of particulate matter at lime manufacturing plants. Currently, hydrators are used to treat about 10 percent of the lime produced in the U.S. Both pressure and atmospheric lime hydrators are covered by the proposed standards.

The format of the proposed standard is a mass-per-unit-of-lime feed. A concentration format was not selected because the gas volume from the hydrator scrubber is not proportional to the production rate and therefore it is not possible to prevent dilution by correcting to zero percent oxygen and water. A low particulate concentration, therefore, would not necessarily result in a low mass emission rate. Since the feed rate of the lime into the hydrator can be easily measured, the emission rate can be calculated directly.

Scrubbers are the most widely used method of particulate control on lime hydrators. EPA source tested two scrubbers in use on atmospheric hydrators. The range of the six test runs on the two facilities was 0.032 to 0.087 kg/Mg (0.065 to 0.173 lb/ton). Compliance with the regulations is determined from an average of three test runs on an affected facility [40 CFR 60.8(f)]. The average of the three tests on the first unit was 0.04 kg/Mg (0.08 lb/T) and the average of the three tests on the second unit was 0.06 kg/Mg (0.12 lb/T). Setting the proposed standard at 0.075 kg/Mg (0.15 lb/ton) assures that the owner or operator of the hydrator would be required to install and operate the best control device.

Due to the presence of a steam plume from the scrubber stack, no accurate visible emissions readings could be taken. EPA believes that an opacity standard for this facility would be ineffective due to enforcement difficulties. No standard of performance limiting visible emissions from the hydrator, therefore, is being proposed.

CONSIDERATION OF IMPACTS

The proposed standards would reduce the particulate emissions from new lime kilns by 99 percent below the levels that would occur with no control and by 70 percent below the levels required by a typical State standard for existing sources. The proposed standards would also reduce particulate emissions from new lime hydrators by 85 percent compared to the requirements of the average State standard. The maximum 24-hour average ambient air concentration of particulate matter due to emissions from a typical lime kiln controlled to the level required by the proposed standard would be about 2.0 micrograms per cubic meter ($\mu g/m^3$).

The secondary environmental impacts due to the proposed standards would be minor. There would be no impact on water pollution. Solid waste handling and disposal problems would be minimal. All of the particulate collected from the hydrators can be returned to the process. When dry control systems are used on the lime kiln, the additional amount of solid waste generated is estimated to be about 3 percent. A negligible amount of particulate matter, sulfur dioxide, and nitrogen oxides would be discharged into the air by the power plant which supplies the additional electrical power required to meet the proposed standards.

In the absence of standards of performance, the lime manufacturing industry would be expected to follow the current trends in particulate control to meet the applicable State standards. It is estimated that 60 percent of the industry would use a baghouse, 20 percent would use a scrubber, and 20 percent would use an ESP for control. The expected distribution of control techniques to comply with the proposed standards is 80 percent baghouse control and 20 percent ESP control. The difference in energy consumption between these two forecasted distributions in the use of various emission control techniques amounts to an energy savings of about 12.6×10^6 kw-hr/yr in 1982. This is equivalent to approximately $9\ m^3$ (55 barrels) of oil per day in 1982 and represents a total energy savings of about 0.2 percent for a new lime manufacturing plant.

The control costs that new, modified, and reconstructed lime plants would incur to meet the emission level required by the proposed standards are considered reasonable. The capital costs for typical new lime plants would be increased by about 3.5 percent. The price of the lime product would increase by only about three percent. The proposed standards, therefore, are expected to have minimal impact on the future growth rate of the lime industry.

TESTING, MONITORING, AND RECORDKEEPING

Performance tests to determine compliance with the proposed standards would be required. Reference Method 5 (40 CFR Part 60, Appendix A) would be used to measure the amount of particulate emissions. In addition, Method 2 for velocity and volumetric flow rate, Method 3 for gas analysis, and Method 4 for stack gas moisture would be used to determine the necessary emission data.

A measurement of the mass rate of feed would also be required during a performance test, because the units of the proposed standards for the rotary lime kiln and the hydrator are kilograms of particulate per megagram of limestone or lime feed. A measuring device such as a conveyor belt scales would be required to determine the mass rate of feed. This device must be accurate to within ±5 percent over its operating range.

The proposed standards would require continuous monitoring of the opacity of the visible emissions discharged from the lime kiln. When a scrubber is used to control the emissions, entrained water droplets prevent the accurate measurement of opacity; therefore, in this case the proposed standard would require monitoring the pressure drop across the scrubber and the scrubbing fluid supply pressure to the scrubber rather than opacity. The pressure sensor or tap for the monitoring device used on the kiln scrubber should be located close to the scrubber liquid discharge point. The Administrator may be consulted for approval of alternative locations.

No opacity data were obtained for emissions from the lime hydrator, and no opacity standard is being proposed. Monitoring of the operating parameters of the scrubber presents a good indication of scrubber performance. The proposed regulations therefore require monitoring of the water flow rate to the scrubber and of the electric current used by the scrubber rather than opacity.

Excess emissions for the lime kiln are defined as all six-minute periods in which the average opacity of the stack plume exceeds 10 percent. The provisions for the reporting of these excess emissions are contained in § 60.7(c) of Part 60. No definition of excess emissions from lime hydrators is included in the proposed regulations since no opacity standard has been developed.

Records of performance tests and continuous monitoring system measurements would have to be retained for at least two years following the date of the measurements by owners and operators subject to this subpart. This requirement is included under § 60.7(d) of the general provisions of Part 60.

MISCELLANEOUS

As prescribed by section 111 of the Act, this proposal of standards has been preceded by the Administrator's determination that emissions from lime manufacturing plants contribute to air pollution which causes or contributes to the endangerment of public health or welfare, and by his publication of this determination in this issue of the FEDERAL REGISTER. In accordance with section 117 of the Act, publication of these proposed standards was preceded by consultation with appropriate advisory committees, independent experts, and Federal departments and agencies.

Interested persons are invited to participate in this rulemaking. The administrator will welcome comments on all aspects of the proposed regulations, including the designation of the source category of lime manufacturing plants as a significant contributor to air pollution which causes or contributes to the endangerment of public health or welfare, economic and technological issues, and the proposed test methods.

Economic Impact Analysis. The screening criteria used by EPA to determine if a proposal is a major action under the Economic Impact Statement program are: (1) additional national annualized compliance costs, including capital charges, will total $100 million within any calendar year by the attainment date, if applicable, or within five years of implementation; (2) total additional cost of production is more than five percent of the selling price; and (3) net national energy consumption will be increased by the equivalent of 25,000 barrels of oil a day (ca. 4,000 m^3 per day). EPA has determined that the impacts associated with the proposal of these standards of performance do not exceed these screening criteria. This action, therefore, does not contain a major proposal requiring preparation of an Economic Impact Analysis under Executive Orders 11821 and 11949 and OMB Circular A-107.

Authority. This notice of proposed rulemaking is issued under the authority of sections 111, 114 and 301(a) of the Clean Air Act, as amended, Pub. L. 91-604, 84 Stat. (42 U.S.C. 1857c-6, 1857c-9, 1857g(a)).

Dated: April 20, 1977.

DOUGLAS M. COSTLE,
Administrator.

It is proposed to amend Part 60 of Chapter I of Title 40 of the Code of Federal Regulations as follows:

1. By adding subpart HH as follows:

Subpart HH—Standards of Performance for Lime Manufacturing Plants

Sec.
60.340 Applicability and designation of affected facility.
60.341 Definitions.
60.342 Standard for particulate matter.
60.343 Monitoring of emissions and operations.
60.344 Test methods and procedures.

AUTHORITY: Secs. 111 and 301(a), Clean Air Act, as amended by sec. 4(a) and sec. 15(c)(2) of Pub. L. 91-604, 84 Stat. 1683, 1713; 81 Stat. 504 (42 U.S.C. 1857c-6, 1857g(a)); secs. 60.343 and 60.344 also issued under sec. 114 Clean Air Act, as amended by sec. 4(a) of Pub. L. 91-604, 84 Stat. 1687 (42 U.S.C. 1857c-9).

Subpart HH—Standards of Performance for Lime Manufacturing Plants

§ 60.340 Applicability and designation of affected facility.

The provisons of this subpart are applicable to the following affected facilities used in the manufacture of lime: rotary lime kilns and lime hydrators.

§ 60.341 Definitions.

As used in this subpart, all terms not defined herein shall have the same meaning given them in the Act and in subpart A of this part.

(a) "Lime manufacturing plant" includes any plant which produces a lime product from limestone by calcination. Hydration of the lime product is also considered to be part of the source.

(b) "Lime product" means the product produced by the calcination process including, but not limited to, calcitic lime, dolomitic lime, and dead-burned dolomite.

(c) "Rotary lime kiln" means a unit with an inclined rotating drum which is used to produce a lime product from limestone by calcination.

(d) "Lime hydrator" means a unit used to produce hydrated lime product.

§ 60.342 Standard for particulate matter.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere:

(1) From any rotary lime kiln any gases which: (i) Contain particulate matter in excess of 0.15 kilogram per megagram of limestone feed; (ii) Exhibit 10 percent opacity or greater.

(2) From any lime hydrator any gases which contain particulate matter in excess of 0.075 kilogram per megagram of lime feed.

§ 60.343 Monitoring of emissions and operations.

(a) The owner or operator subject to the provisions of this subpart shall install, calibrate, maintain, and operate a continuous monitoring system, except as provided in paragraph (b) of this section, to monitor and record the opacity of the gases discharged into the atmosphere from any rotary lime kiln. The span of this system shall be set at 40 percent opacity.

(b) The owner or operator of any rotary lime kiln using a wet scrubbing emission control devise subject to the provisions of this subpart shall not be required to monitor the opacity of the gases discharged as required in paragraph (a) of this section, but shall install, calibrate, maintain, and operate the following continuous monitoring devices:

(1) A monitoring device for the continuous measurement of the pressure loss of the gas stream through the scrubber. The monitoring device must be accurate within ±250 pascals gauge pressure.

(2) A monitoring device for the continuous measurement of the scrubbing liquid supply pressure to the control device. The monitoring device must be accurate within ±5 percent of design scrubbing liquid supply pressure.

(c) The owner or operator of any lime hydrator using a wet scrubbing emission control device subject to the provisions of this subpart shall install, calibrate, maintain, and operate the following continuous monitoring devices:

(1) A monitoring device for the continuous measuring of the scrubbing liquid flow rate. The monitoring device must be accurate within ±5 percent of design scrubbing liquid flow rate.

(2) A monitoring device for the continuous measuring of the electric current, in amperes, used by the scrubber. The monitoring device must be accurate within ±10 percent over its normal operating range.

(d) For the purpose of conducting a performance test under § 60.8, the owner or operator of any lime manufacturing plant subject to the provisions of this subpart shall install, calibrate, maintain and operate a device for measuring the mass rate of limestone feed to any affected rotary lime kiln and the mass rate of lime feed to any affected lime hydrator. The measuring device used must be accurate to within ±5 percent of the mass rate over its operating range.

(e) For the purpose of reports required under § 60.7(c), periods of excess emissions that shall be reported are defined as all six-minute periods during which the average opacity of the plume from any lime kiln subject to paragraph (a) of this subpart exceeds 10 percent.

§ 60.344 Test methods and procedures.

(a) Reference methods in Appendix A of this part, except as provided under § 60.8(b) shall be used to determine compliance with § 60.322(a) as follows:

(1) Method 5 for the measurement of particulate matter,

(2) Method 1 for sample and velocity traverses,

(3) Method 2 for velocity and volumetric flow rate,

(4) Method 3 for gas analysis,

(5) Method 4 for stack gas moisture, and

(6) Method 9 for visible emissions.

(b) For Method 5, the sampling time for each run shall be at least 60 minutes and the sampling rate shall be at least 0.85 dscm/hr (0.53 dscf/min), except that shorter sampling times, when necessitated by process variables or other factors, may be approved by the Administrator.

[FR Doc.77-12463 Filed 5-2-77;8:45 am]

Title 40—Protection of Environment

CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY

SUBCHAPTER C—AIR PROGRAMS

[FRL 423-6]

PART 51—REQUIREMENTS FOR THE PREPARATION, ADOPTION AND SUBMITTAL OF IMPLEMENTATION PLANS

Emission Monitoring of Stationary Sources

On September 11, 1974, the Environmental Protection Agency (EPA) proposed revisions to 40 CFR Part 51, Requirements for the Preparation, Adoption, and Submittal of Implementation Plans. EPA proposed to expand § 51.19 to require States to revise their State Implementation Plans (SIP's) to include legally enforceable procedures requiring certain specified categories of existing stationary sources to monitor emissions on a continuous basis. Revised SIP's submitted by States in response to the proposed revisions to 40 CFR 51.19 would have (1) required owners or operators of specified categories of stationary sources to install emission monitoring equipment within one year of plan approval, (2) specified the categories of sources subject to the requirements, (3) identified for each category of sources the pollutant(s) which must be monitored, (4) set forth performance specifications for continuous emission monitoring instruments, (5) required that such instruments meet performance specifications through on-site testing by the owner or operator, and (6) required that data derived from such monitoring be summarized and made available to the State on a quarterly basis.

As a minimum, EPA proposed that States must adopt and implement legally enforceable procedures to require monitoring of emissions for existing sources in the following source categories (but only for sources required to limit emissions to comply with an adopted regulation of the State Implementation Plan):

(a) Coal-fired steam generators of more than 250 million BTU per hour heat input (opacity, sulfur dioxide, oxides of nitrogen and oxygen);

(b) Oil-fired steam generators of more than 250 million BTU per hour heat input (sulfur dioxide, oxides of nitrogen and oxygen). An opacity monitor was required only if an emission control device is needed to meet particulate emission regulations, or if violations of visible emission regulations are noted;

(c) Nitric acid plants (oxides of nitrogen);

(d) Sulfuric acid plants (sulfur dioxide); and

(e) Petroleum refineries' fluid catalytic cracking unit catalyst regenerators (opacity).

Simultaneously, the Agency proposed similar continuous emission monitoring requirements for new sources for each of the previously identified source categories, subject to the provisions of federal New Source Performance Standards set forth in 40 CFR Part 60. Since many of the technical aspects of the two proposals were similar, if not the same, the proposed regulations for Part 51 (i.e., those relating to SIP's and existing sources) included by reference many specific technical details set forth in 40 CFR Part 60, (39 FR 32852).

At the time of the proposal of the continuous emission monitoring regulations in the FEDERAL REGISTER, the Agency invited comments on the proposed rulemaking action. Many interested parties submitted comments. Of the 76 comments received, 35 were from electric utility companies, 26 were from oil refineries or other industrial companies, 12 were from governmental agencies, and 3 were from manufacturers and/or suppliers of emission monitors. No comments were received from environmental groups. Further, prior to the proposal of the regulations in the FEDERAL REGISTER, the Agency sought comments from various State and local air pollution control agencies and instrument manufacturers. Copies of each of these comments are available for public inspection at the EPA Freedom of Information Center, 401 M Street, S.W., Washington, D.C. 20460. These comments have been considered, additional information collected and assessed, and where determined by the Administrator to be appropriate, revisions and amendments have been made in formulating these regulations promulgated herein.

General Discussion of Comments. In general, the comments received by the Agency tended to raise various objections with specific portions of the regulations. Some misinterpreted the proposed regulations, not realizing that emission monitoring under the proposal was not required unless a source was required to comply with an adopted emission limitation or sulfur in fuel limitation that was part of an approved or promulgated State Implementation Plan. Many questioned the Agency's authority and the need to require sources to use *continuous* emission monitors. Others stated that the proposed regulations were inflationary, and by themselves could not reduce emissions to the atmosphere nor could they improve air quality. A relatively common comment was that the benefits to be derived from the proposed emission monitoring program were not commensurate with the costs associated with the purchase, installation, and operation of such monitors. Many stated that the proposed regulations were not cost-effectively applied and they objected to *all* sources within an identified source category being required to monitor emissions, without regard for other considerations. For instance, some suggested that it was unnecessary to monitor emissions from steam generating plants that may soon be retired from operation, or steam generating boilers that are infrequently used (such as for peaking and cycling operations) or for those sources located in areas of the nation which presently have ambient concentrations better than national ambient air quality standards. This latter comment was especially prevalent in relation to the need for continuous emission monitors designed to measure emissions of oxides of nitrogen. Further, commentors generally suggested that state and local control agencies, rather than EPA should be responsible for determining which sources should monitor emissions. In this regard, the commentors suggested that a determination of the sources which should install continuous monitors should be made on a case-by-case basis. Almost all objected to the data reporting requirements stating that the proposed requirement of submission of all collected data was excessive and burdensome. Comments from state and local air pollution control agencies in general were similar to those from the utility and industrial groups, but in addition, some indicated that the manpower needed to implement the programs required by the proposed regulations was not available.

Rationale for Emission Monitoring Regulation. Presently, the Agency's regulations setting forth the requirements for approvable SIP's require States to have legal authority to require owners or operators of stationary sources to install, maintain, and use emission monitoring devices and to make periodic reports of emission data to the State (40 CFR 51.11(a)(6)). This requirement was designed to partially implement the requirements of Sections 110(a)(2)(F)(ii) and (iii) of the Clean Air Act, which state that implementation plans must provide "requirements for installation of equipment by owners or operators of stationary sources to monitor emissions from such sources", and "for periodic reports on the nature and amounts of such emissions". However, the original implementation plan requirements did not require SIP's to contain legally enforceable procedures mandating continuous emission monitoring and recording. At the time the original requirements were published, the Agency had accumulated little data on the availability and reliability of continuous monitoring devices. The Agency believed that the state-of-the-art was such that it was not prudent to require existing sources to install such devices.

Since that time, much work has been done by the Agency and others to field test and compare various continuous emission monitors. As a result of this work, the Agency now believes that for certain sources, performance specifications for accuracy, reliability and durability can be established for continuous emission monitors of oxygen, carbon dioxide, sulfur dioxide, and oxides of nitrogen and for the continuous measurement of opacity. Accordingly, it is the Administrator's judgment that Sections 110(a)(2)(F)(ii) and (iii) should now be more fully implemented.

The Administrator believes that a sound program of continuous emission monitoring and reporting will play an important role in the effort to attain and maintain national standards. At the present time, control agencies rely upon infrequent manual source tests and periodic field inspections to provide much of the enforcement information necessary to ascertain compliance of sources with adopted regulations. Manual source tests are generally performed on a relatively infrequent basis, such as once per year, and in some cases, affected sources probably have never been tested. Manual stack tests are generally performed under optimum operating conditions, and as such, do not reflect the full-time emission conditions from a source. Emissions continually vary with fuel firing rates, process material feed rates and various other operating conditions. Since manual stack tests are only conducted for a relatively short period of time (e.g., one to three hours), they cannot be representative of all operating conditions. Further, frequent manual stack tests (such as conducted on a quarterly or more frequent basis) are costly and may be more expensive than continuous monitors that provide much more information. State Agency enforcement by field inspection is also sporadic, with only occasional inspection of certain sources, mainly for visible emission enforcement.

Continuous emission monitoring and recording systems, on the other hand, can provide a continuous record of emissions under all operating conditions. The continuous emission monitor is a good indicator of whether a source is using good operating and maintenance practices to minimize emissions to the atmosphere and can also provide a valuable record to indicate the performance of a source in complying with applicable emission control regulations. Additionally, under certain instances, the data from continuous monitors may be sufficient evidence to issue a notice of violation. The continuous emission record can also be utilized to signal a plant upset or equipment malfunction so that the plant operator can take corrective action to reduce emissions. Use of emission monitors can therefore provide valuable information to minimize emissions to the atmosphere and to assure that full-time control efforts, such as good maintenance and operating conditions, are being utilized by source operators.

The Agency believes that it is necessary to establish national minimum requirements for emission monitors for specified sources rather than allow States to determine on a case-by-case basis the specific sources which need to continuously monitor emissions. The categories specified in the regulations represent very significant sources of emissions to the atmosphere. States in developing SIP's have generally adopted control regulations to minimize emissions from these sources. Where such regulations exist, the Agency believes that continuous emission monitors are necessary to provide information that may be used to provide an indication of source compliance. Further, it is believed that if the selection of sources on a case-by-case basis were left to the States, that some States would probably not undertake an adequate emission monitoring program. Some State Agencies who commented on the proposed regulations questioned the state-of-the-art of emission monitoring and stated their opinion that the proposed requirements were premature. Therefore, it is the Administrator's judgment that, in order to assure an adequate nationwide emission monitoring program, minimum emission monitoring requirements must be established.

The source categories affected by the regulations were selected because they are significant sources of emissions and because the Agency's work at the time of the proposal of these regulations in the field of continuous emission monitoring evaluation focused almost exclusively on these source categories. The Agency is continuing to develop data on monitoring devices for additional source categories. It is EPA's intent to expand the minimum continuous emission monitoring requirements from time to time when the economic and technological feasibility of continuous monitoring equipment is demonstrated and where such monitoring is deemed appropriate for other significant source categories.

Discussion of Major Comments. Many commentors discussed the various cost aspects of the proposed regulations, specifically stating that the costs of continuous monitors were excessive and inflationary. A total of 47 commentors expressed concern for the cost and/or cost effectiveness of continuous monitors. Further, the Agency's cost estimates for purchasing and installing monitoring systems and the costs for data reduction and reporting were questioned. In many cases, sources provided cost estimates for installation and operation of continuous monitors considerably in excess of the cost estimates provided by the Agency.

In response to these comments, a further review was undertaken by the Agency to assess the cost impact of the regulations. Three conclusions resulted from this review. First, it was determined that the cost ranges of the various emission monitoring systems provided by the Agency are generally accurate for new sources. Discussions with equipment manufacturers and suppliers confirmed this cost information. Approximate investment costs, which include the cost of the emission monitor, installation cost at a *new* facility, recorder, performance testing, data reporting systems and associated engineering costs are as follows: for opacity, $20,000; for sulfur dioxide and oxygen or oxides of nitrogen and oxygen, $30,000; and for a source that monitors opacity, oxides of nitrogen, sulfur dioxide and oxygen, $55,000. Annual operating costs, which include data reduction and report preparation, system operation, maintenance, utilities, taxes, insurance and annualized capital costs at 10% for 8 years are: $8,500; $16,000; and $30,000 respectively for the cases described above.(1)

Secondly, the cost review indicated that the cost of installation of emission monitors for existing sources could be considerably higher than for new sources because of the difficulties in providing access to a sampling location that can provide a representative sample of emissions. The cost estimates provided by the Agency in the proposal were specifically developed for *new* sources whose installation costs are relatively stable since provisions for monitoring equipment can be incorporated at the time of plant design. This feature is not available for existing sources, hence higher costs generally result. Actual costs of installation at existing sources may vary from one to five times the cost of normal installation at new sources, and in some cases even higher costs can result. For example, discussions with instrument suppliers indicate that a typical cost of installation of an opacity monitor on an existing source may be two to three times the purchase price of the monitor. Difficulties also exist for installation of gaseous monitors at existing sources.

It should be noted that these installation costs include material costs for scaffolding, ladders, sampling ports and other items necessary to provide access to a location where source emissions can be measured. It is the Agency's opinion that such costs cannot be solely attributed to these continuous emission monitoring regulations. Access to sampling locations is generally necessary to determine compliance with applicable State or local emission limitations by routine manual stack testing methods. Therefore, costs of providing access to a representative sampling location are more directly attributed to the cost of compliance with adopted emission limitations, than with these continuous emission monitoring regulations.

Lastly, the review of cost information indicated that a number of commentors misinterpreted the extent of the proposed regulations, thereby providing cost estimates for continuous monitors which were not required. Specifically, all commentors did not recognize that the proposed regulations required emission monitoring for a source only if an applicable State or local emission limitation of an approved SIP affected such a source. For example, if the approved SIP did not contain an adopted control regulation to limit oxides of nitrogen from steam-generating, fossil fuel-fired boilers of a capacity in excess of 250 million BTU per hour heat input, then such source need not monitor oxides of nitrogen emissions. Further, some utility industry commentors included the costs of continuous emission monitors for sulfur dioxide. The proposed regulations, however, generally allowed the use of fuel analysis by specified ASTM procedures as an alternative which, in most cases, is less expensive than continuous monitoring. Finally, the proposed regulations required the continuous monitoring of oxygen in the exhaust gas only if the source must otherwise continuously monitor oxides of nitrogen or sulfur dioxide. Oxygen information is used solely to provide a correction for excess air when converting the measurements of gaseous pollutants concentrations in the exhaust gas stream to units of an applicable emission limitation. Some commentors did not recognize this point (which was not specifically stated in the proposed regulations) and provided cost estimates for oxygen monitors when they were not required by the proposed regulations.

While not all commentors' cost estimates were correct, for various reasons noted above, it is clear that the costs associated with implementing these emission monitoring regulations are significant. The Administrator, however, believes that the benefits to be derived from emission monitoring are such that the costs are not unreasonable. The Administrator does, however, agree with many commentors that the proposed regulations, in some cases, were not applied cost-effectively and, as such, the regulations promulgated herein have been modified to provide exemptions to certain sources from these minimum requirements.

One comment from another Federal Agency concerned the time period that emissions are to be averaged when reporting excess emissions. Specifically, the commentor assumed that the emission control regulations that have been adopted by State and local agencies were generally designed to attain *annual* ambient air quality standards. As such, the commentor pointed out that short-term emission levels in excess of the adopted emission standard should be acceptable for reasonable periods of time.

The Administrator does not agree with this rationale for the following reasons. First, it is not universally true that annual ambient standards were the design basis of emission control regulations. In many cases, reductions to attain short-term standards require more control than do annual standards. Even if the regulations were based upon annual standards, allowing excess emissions of the adopted emission control regulation on a short-term basis could cause noncompliance with annual standards. More importantly, however, a policy of legally allowing excesses of adopted control regulations would in effect make the current emission limitation unenforceable. If the suggestion were implemented, a question would arise as to what is the maximum emission level that would not be considered an excess to the adopted regulation. The purpose of the adopted emission limitation was to establish the acceptable emission level. Allowing emissions in excess of that adopted level would cause confusion, ambiguity, and in many cases could result in an unenforceable situation. Hence the Administrator does not concur with the commentor's suggestion.

Modifications to the Proposed Regulations. The modification to the regulations which has the most significant impact involves the monitoring requirements for oxides of nitrogen at fossil fuel-fired steam generating boilers and at nitric acid plants. Many commentors correctly noted that the Agency in the past (June 8, 1973, 38 FR 15174) had indicated that the need for many emission control regulations for oxides of nitrogen were based upon erroneous data. Such a statement was made after a detailed laboratory analysis of the reference ambient measurement method for nitrogen dioxide revealed the method to give false measurements. The sampling technique generally indicated concentrations of nitrogen dioxide higher than actually existed in the atmosphere. Since many control agencies prior to that announcement had adopted emission regulations that were determined to be needed based upon these erroneous data, and since new data, collected by other measurement techniques, indicated that in most areas of the nation such control regulations were not necessary to satisfy the requirements of the SIP, the Agency suggested that States consider the withdrawal of adopted control regulations for the control of oxides of nitrogen from their SIP's (May 8, 1974, 39 FR 16344). In many States, control agencies have not taken action to remove these regulations from the SIP. Hence, the commentors pointed out that the proposed regulations to require continuous emission monitors on sources affected by such regulations is generally unnecessary.

Because of the unique situation involving oxides of nitrogen control regulations, the Administrator has determined that the proposed regulations to continuously monitor oxides of nitrogen emissions may place an undue burden on source operators, at least from a standpoint of EPA specifying minimum monitoring requirements. The continuous emission monitoring requirements for such sources therefore have been modified. The final regulations require the continuous emission monitoring of oxides of nitrogen only for those sources in Air Quality Control Regions (AQCR's) where the Administrator has specifically determined that a control strategy for nitrogen dioxide is necessary. At the present time such control strategies are required only for the Metropolitan Los Angeles Intrastate and the Metropolitan Chicago Interstate AQCR's.

It should be noted that a recent compilation of valid nitrogen dioxide air quality data suggests that approximately 14 of the other 245 AQCR's in the nation may need to develop a control strategy for nitrogen dioxide. These AQCR's are presently being evaluated by the Agency. If any additional AQCR's are identified as needing a control strategy for nitrogen dioxide at that time, or any time subsequent to this promulgation, then States in which those AQCR's are located must also revise their SIP's to require continuous emission monitoring for oxides of nitrogen for specified sources. Further, it should be noted that the regulations promulgated today are minimum requirements, so that States, if they believe the control of oxides of nitrogen from sources is necessary may, as they deem appropriate, expand the continuous emission monitoring requirements to apply to additional sources not affected by these minimum requirements.

Other modifications to the proposed regulation resulted from various comments. A number of commentors noted that the proposed regulations included some sources whose emission impact on air quality was relatively minor. Specifically, they noted that fossil fuel-fired steam generating units that were used solely for peaking and cycling purposes should be exempt from the proposed regulations. Similarly, some suggested that smaller sized units, particularly steam-generating units less than 2,500 million BTU per hour heat input, should also be exempted. Others pointed out that units soon to be retired from operation should not be required to install continuous monitoring devices and that sources located in areas of the nation that already have air quality better than the national standards should be relieved of the required monitoring and reporting requirements. The Agency has considered these comments and has made the following judgments.

In relation to fossil fuel-fired steam generating units, the Agency has determined that such units that have an annual boiler capacity factor of 30% or less as currently defined by the Federal Power Commission shall be exempt from the minimum requirements for monitoring and reporting. Industrial boilers used at less than 30% of their annual capacity, upon demonstration to the State, may also be granted an exemption from these monitoring requirements. The rationale for this exemption is based upon the fact that all generating units do not produce power at their full capacity at all times. There are three major classifications of power plants based on the degree to which their rated capacity is utilized on an annual basis. Baseload units are designed to run at near full capacity almost continuously. Peaking units are operated to supply electricity during periods of maximum system demand. Units which are operated for intermediate service between the extremes of baseload and peaking are termed cycling units.

Generally accepted definitions term units generating 60 percent or more of their annual capacity as baseload, those generating less than 20 percent as peaking and those between 20 and 60 percent as cycling. In general, peaking units are older, smaller, of lower efficiency, and more costly to operate than base load or cycling units. Cycling units are also generally older, smaller and less efficient than base load units. Since the expected life of peaking units is relatively short and total emissions from such units are small, the benefits gained by installing monitoring instruments are small in comparison to the cost of such equipment. For cycling units, the question of cost-effectiveness is more difficult to ascertain. The units at the upper end of the capacity factor range (i.e., near 60% boiler capacity factor) are candidates for continuous emission monitoring while units at the lower end of the range (i.e., near 20% boiler capacity factor) do not represent good choices for continuous monitors. Based upon available emission information, it has been calculated that fossil fuel-fired steam generating plants with a 30% or less annual boiler capacity factor contribute approximately less than 5% of the total sulfur dioxide from all such power plants. (2) Hence, the final regulations do not affect any boiler that has an annual boiler capacity factor of less than 30%. Monitoring requirements will thus be more cost effectively applied to the newer, larger, and more efficient units that burn a relatively larger portion of the total fuel supply.

Some commentors noted that the age of the facility should be considered in relation to whether a source need comply with the proposed regulations. For fossil fuel-fired steam generating units, the exemption relating to the annual boiler capacity factor previously discussed should generally provide relief for older units. It is appropriate, however, that the age of the facility be considered for other categories of sources affected by the proposed regulations. As such, the final regulations allow that any source that is scheduled to be retired within five years of the inclusion of monitoring requirements for the source in Appendix P need not comply with the minimum emission monitoring requirements promulgated herein. In the Administrator's judgment, the selection of five years as the allowable period for this exemption provides reasonable relief for those units that will shortly be retired. However, it maintains full requirements on many older units with a number of years of service remaining. In general, older units operate less efficiently and are less well controlled than newer units so that emission monitoring is generally useful. The exemption provided in the final regulations effectively allows such retirees slightly more than a two-year period of relief, since the schedule of implementation of the regulations would generally require the installation of emission monitors by early 1978. States must submit, for EPA approval, the procedures they will implement to use this provision. States are advised that such exemptions should only be provided where a bona fide intent to cease operations has been clearly established. In cases where such sources postpone retirement, States shall have established procedures to require such sources to monitor and report emissions. In this regard, it should be noted that Section 113(c)(2) of the Act provides that any person who falsifies or misrepresents a record, report or other document filed or required under the Act shall, upon conviction, be subject to fine or imprisonment, or both.

A further modification to the proposed regulations affects the minimum size of the units within each of the source categories to which emission monitoring and reporting shall be required. As suggested by many commentors, the Agency has investigated the cost effectiveness of requiring all units within the identified source categories to install emission monitors. Each pollutant for each source category identified in the proposed regulations was evaluated. For fossil fuel-fired steam generating units, the proposal required compliance for all boilers with 250 million BTU per hour heat input, or greater. For opacity, the proposed regulations required emission monitoring for all coal-fired units, while only those oil-fired units that had been observed as violators of visible emission regulations or must use an emission control device to meet particulate matter regulations were required to install such devices. Gas-fired units were exempted by the proposed regulations.

After investigating the particulate emission potential of these sources, it has been determined that no modification in the size limitation for boilers in relation to opacity is warranted. The rationale for this judgment is that the smaller-sized units affected by the proposed regulation tend to be less efficiently operated or controlled for particulate matter than are the larger-sized units. In fact, smaller units generally tend to emit more particulate emissions on an equivalent fuel basis than larger-sized units. (2) Because of the potential of opacity regulation violations, no modifications have been made to the regulations as to the size of steam generating boilers that must measure opacity.

Emissions of oxides of nitrogen from boilers are a function of the temperature in the combustion chamber and the cooling of the combustion products. Emissions vary considerably with the size and the type of unit. In general, the larger units produce more oxides of nitrogen emissions. The Agency therefore finds that the minimum size of a unit affected by the final regulations can be increased from 250 to 1,000 million BTU per hour heat input, without significantly reducing the total emissions of oxides of nitrogen that would be affected by monitoring and reporting requirements. Such a modification would have the effect of exempting approximately [illegible]6% of the boilers over 250 million BTU per hour heat input capacity, on a national basis, while maintaining emission monitoring and reporting requirements for approximately 78% of the potential oxides of nitrogen emissions from such sources.(2) Further, in the 2 AQCR's where the Administrator has specifically called for a control strategy for nitrogen dioxide, the boilers affected by the regulation constitute 50% of the steam generators greater than 250 million BTU per hour heat input, yet they emit 80% of the nitrogen oxides from such steam generators in these 2 AQCR's.(2)

Also, certain types of boilers or burners, due to their design characteristics, may on a regular basis attain emission levels of oxides of nitrogen well below the emission limitations of the applicable plan. The regulations have been revised to allow exemption from the requirements for installing emission monitoring and recording equipment for oxides of nitrogen when a facility is shown during performance tests to operate with oxides of nitrogen emission levels 30% or more below the emission limitation of the applicable plan. It should be noted that this provision applies solely to oxides of nitrogen emissions rather than other pollutant emissions, since oxides of nitrogen emissions are more directly related to boiler design characteristics than are other pollutants.

Similar evaluations were made for nitric acid plants, sulfuric acid plants and catalytic cracking unit catalyst regenerators at petroleum refineries. For each of these industries it was found that modifications to the proposed regulations could be made to increase the minimum size of the units affected by the proposed regulations without significantly decreasing the total emissions of various pollutants that would be affected by these monitoring and reporting requirements. Specifically, for nitric acid plants it was found that by modifying the proposed regulations to affect only those plants that have a total daily production capacity of 300 tons or more of nitric acid (rather than affecting all facilities as proposed) that approximately 79% of the nitric acid production on a national basis would be affected by the provisions of these monitoring and reporting requirements. On the other hand, such a modification reduces the number of monitors required for compliance with these regulations by approximately 46%. (2) At the present time, only nitric acid plants in AQCR's where the Administrator has specifically called for a control strategy for nitrogen dioxide will be candidates for continuous emission monitoring requirements for the reasons mentioned previously. In the 2 AQCR's where such a control strategy has been called for, there is only one known nitric acid plant and that is reported to be less than 300 tons per day production capacity—hence no nitric acid plants at the present time will be affected by these monitoring requirements.

Similarly, evaluations of sulfuric acid plants and catalytic cracking catalyst regenerators at petroleum refineries resulted in the conclusion that minimum size limitations of 300 tons per day production rate at sulfuric acid plants, and 20,000 barrels per day of fresh feed to any catalytic cracking unit at petroleum refineries could be reasonably established. Such modifications exempt approximately 37% and 39% respectively of such plants on a national basis from these emission monitoring and reporting requirements, while allowing about 9% of the sulfur dioxide emissions from sulfuric acid plants and 12% of the particulate matter emissions from catalytic cracking units to be emitted to the atmosphere without being measured and reported. (2) The Agency believe that such modifications provide a reasonable balance between the costs associated with emission monitoring and reporting, and the need to obtain such information.

A number of commentors suggested that sources be exempt from the proposed emission monitoring regulations if such sources are located within areas of the nation that are already attaining national standards. The Administrator does not believe that such an approach would be consistent with Section 110 of the Clean Air Act, which requires continued maintenance of ambient standards after attainment. In many areas, the standards are being attained only through effective implementation of emission limitations. Under the Clean Air Act, continued compliance with emission limitations in these areas is just as important as compliance in areas which have not attained the standards.

Another major comment concerned the proposed data reporting requirements. Thirty-four (34) commentors expressed concern at the amount of data which the proposed regulations required to be recorded, summarized, and submitted to the State. It was generally indicated by the commentors that the data reporting requirements were excessive. Commentors questioned the purpose of reporting all measured data while some State agencies indicated they have limited resources to handle such information. EPA believes that, in some cases, the commentors misconstrued the data reporting requirements for existing sources. In light of each of these comments, the final regulations, with respect to the data reporting requirements for gaseous pollutants and opacity, have been modified.

For gaseous emissions, the proposed regulations required the reporting of all one-hour averages obtained by the emission monitor. Because of the comments on this provision, the Agency has reexamined the proposed data reporting requirements. As a result, the Agency has determined that only information concerning emissions in excess of emission limitations of the applicable plan is necessary to satisfy the intent of these regulations. Therefore, the data reporting requirements for gaseous pollutants have been modified. The final regulations require that States adopt procedures that would require sources to report to the State on emission levels in excess of the applicable emission limitations (i.e., excess emissions) for the time period specified in the regulation with which compliance is determined. In other words, if an applicable emission limitation required no more than 1.0 pounds per hour SO_2 to be emitted for any two-hour averaging period, the data to be reported by the source should identify the emission level (i.e., emissions stated in pounds per hour) averaged over a two-hour time period, for periods only when this emission level was in excess of the 1.0 pounds per hour emission limitation. Further, sources shall be required to maintain a record of all continuous monitoring observations for gaseous pollutants (and opacity measurements) for a period of two years and to make such data available to the State upon request. The final regulations have also been amended to add a provision to require sources to report to the State on the apparent reason for all noted violations of applicable regulations.

The proposed data reporting requirements for opacity have also been modified. Upon reconsideration of the extent of the data needed to satisfy the intent of these regulations, it is the Administrator's judgment that for opacity States must obtain excess emission measurements during each hour of operation. However, before determining excess emissions, the number of minutes generally exempted by State opacity regulations should be considered. For example, where a regulation allows two minutes of opacity measurements in excess of the standard, the State need only require the source to report all opacity measurements in excess of the standard during any one hour, minus the two-minute exemption. The excess measurements shall be reported in actual per cent opacity averaged for one clock minute or such other time period deemed appropriate by the State. Averages may be calculated either by arithmetically averaging a minimum of 4 equally spaced data points per minute or by integration of the monitor output.

Some commentors raised questions concerning the provisions in the proposed regulations which allow the use of fuel analysis for computing emissions of sulfur dioxide in lieu of installing a continuous monitoring device for this pollutant. Of primary concern with the fuel analysis approach among the commentors was the frequency of the analysis to determine the sulfur content of the fuel. However, upon inspection of the comments by the Agency, a more significant issue has been uncovered. The issue involves the determination of what constitutes excess emissions when a fuel analysis is used as the method to measure source emissions. For example, the sulfur content varies significantly within a load of coal, i.e., while the *average* sulfur content of a total load of coal may be within acceptable limits in relation to a control regulation which restricts the sulfur content of coal, it is probable that portions of the coal may have a sulfur content above the allowable level. Similarly, when fuel oils of different specific gravities are stored within a common tank, such fuel oils tend to stratify and may not be a homogeneous mixture. Thus, at times, fuel oil in excess of allowable limits may be combusted. The question which arises is whether the combustion of this higher sulfur coal or oil is a violation of an applicable sulfur content regulation. Initial investigations of this issue have indicated a relative lack of specificity on the subject.

The Agency is confronted with this problem not only in relation to specifying procedures for the emission reporting requirements for existing sources but also in relation to enforcement considerations for new sources affected by New Source Performance Standards. At this time, a more thorough investigation of the situation in necessary prior to promulgation of procedures dealing with fuel analysis for both oil and coal. At the conclusion of this investigation, the Agency will set forth its findings and provide guidance to State and local control agencies on this issue. In the meantime, the portion of the proposed regulations dealing with fuel analysis is being withheld from promulgation at this time. As such, States shall not be required to adopt provisions dealing with emission monitoring or reporting of sulfur dioxide emissions from those sources where the States may choose to allow the option of fuel analysis as an alternative to sulfur dioxide monitoring. However, since the fuel analysis alternative may not be utilized by a source that has installed sulfur dioxide control equipment (scrubbers), States shall set forth legally enforceable procedures which require emission monitors on such sources, where these emission monitoring regulations otherwise require their installation.

Other Modifications to Proposed Regulations. In addition to reducing the number of monitors required under the proposed regulations, a number of modifications to various procedures in the proposed regulations have been considered and are included in the final regulations. One modification which has been made is the deletion of the requirement to install continuous monitors at "the most representative" location. The final regulations require the placement of an emission monitor at "a representative" location in the exhaust gas system. In many cases "the most representative" location may be difficult to locate and may be inaccessible without new platforms, ladders, etc., being installed. Further, other representative locations can provide adequate information on pollutant emissions if minimum criteria for selection of monitoring locations are observed. Guidance in determining a representative sampling location is contained within the Performance Specification for each pollutant monitor in the emission monitoring regulations for New Source Performance Standards (Appendix B, Part 60 of this Chapter). While these criteria are designed for new sources, they are also useful in determining representative locations for existing sources.

A further modification to the proposed regulation is the deletion of the requirement for new performance tests when continuous emission monitoring equipment is modified or repaired. As proposed, the regulation would have required a new performance test whenever any part of the continuous emission monitoring system was replaced. This requirement was originally incorporated in the regulations to assure the use of a well-calibrated, finely tuned monitor. Commentors pointed out that the requirement of conducting new performance tests whenever any part of an instrument is changed or replaced is costly and in many cases not required. Upon evaluation of this comment, the Administrator concurs that performance tests are not required after each repair or replacement to the system. Appropriate changes have been made to the regulations to delete the requirements for new performance tests. However, the final regulations require the reporting of the various repairs made to the emission monitoring system during each quarter to the State. Further, the State must have procedures to require sources to report to the State on a quarterly basis information on the amount of time and the reason why the continuous monitor was not in operation. Also the State must have legally enforceable procedures to require a source to conduct a new performance test whenever, on the basis of available information, the State deems such test is necessary.

The time period proposed for the installation of the required monitoring system, i.e., one year after plan approval, was thought by 21 commentors to be too brief, primarily because of lack of available instruments, the lack of trained personnel and the time available for installation of the required monitors. Equipment suppliers were contacted by the Agency and they confirmed the availability of emission monitors. However, the Administrator has determined that the time necessary for purchase, installation and performance testing of such monitors may require more than one year for certain installations, especially where gaseous monitors are required. In order to provide sources with ample time, the Agency has modified the final regulations to allow States to adopt procedures that will provide sources 18 months after the approval or promulgation of the revised SIP to satisfy the installation and performance testing procedures required by these continuous monitoring regulations. A provision is also included to allow, on a case-by-case basis, additional extensions for sources where good faith efforts have been undertaken to purchase and install equipment, but where such installation cannot be accomplished within the time period prescribed by the regulations.

A number of State and local agencies also commented on the lack of time provided sources to install the monitors required by the proposed regulations. These agencies also indicated that they must acquire sufficient skilled manpower to implement the regulations, such as personnel to provide guidance to sources, to monitor performance tests and to analyze the emission data that are to be submitted by the sources. Further, some State agencies indicated that more than six months was needed to develop the necessary plan revisions. Most State agencies who commented stated that one year should be provided to allow States to revise their SIP's. The Administrator is aware of the various priorities which confront State and local agencies at this time (e.g., compliance schedules, enforcement actions, litigation proceedings, reevaluation of adequacy of SIP's to attain and maintain national standards, etc.) and, as such, believes that a six-month postponement in the submittal of plan revisions to require emission monitoring and reporting is justified and prudent. Hence, States must submit plan revisions to satisfy the requirements of this section within one year of promulgation of these regulations in the FEDERAL REGISTER. However, States are advised that such plan revisions may be submitted any time prior to the final date, and are encouraged to do so where possible.

The proposed regulations provided the States with the option of allowing sources to continue to use emission monitoring equipment that does not meet performance specifications set forth in the regulations for up to five years from the date of approval of the State regulations or EPA promulgation. Some commenters asked that this provision be extended indefinitely. In some cases they indicated they had recently purchased and had already installed monitoring systems which were only marginally away from meeting the applicable performance specifications. The Agency believes, however, that such a modification to the proposed regulations should not be allowed. It is believed that such a provision would result in inadequate monitoring systems being maintained after their useful life has ended. Though some monitoring systems will probably last longer than five years, it is believed that this time period will provide adequate time to amortize the cost of such equipment. In cases where existing emission monitors are known not to provide reasonable estimates of emissions, States should consider more stringent procedures to provide a more speedy retirement of such emission monitoring systems.

Some commentors raised the question of whether existing oxygen monitors which are installed in most fossil fuel-fired steam generating boilers to monitor excess oxygen for the purposes of combustion control could be used to satisfy the requirement for monitoring oxygen under the proposal. Upon investigation, it has been determined that, in some cases, such oxygen monitors may be used provided that they are located so that there is no influx of dilution air between the oxygen monitor and the continuous pollutant monitor. In some cases, it may be possible to install the continuous monitoring device at the same location as the existing oxygen monitor. Care should be taken, however, to assure that a representative sample is obtained. Because of the various possibilities that may arise concerning the usefulness of existing oxygen monitors, the State should determine, after a case-by-case review, the acceptability of existing oxygen monitors.

Another technical issue which was raised suggested that continuous emission monitors which provide direct measurements of pollutants in units comparable to the emission limitations and other devices not specifically identified in the proposed regulations are available for purchase and installation. The Agency is aware that various monitoring systems exist but has not as yet determined specific performance specifications for these monitoring systems that are directly applicable to the source categories covered by these regulations. However, it is not EPA's intent to deny the use of any equipment that can be demonstrated to be reliable and accurate. If monitors can be demonstrated to provide the same relative degree of accuracy and durability as provided by the performance specifications in Appendix B of Part 60, they shall generally be acceptable to satisfy the requirements of these regulations under Section 3.9 of Appendix P. Further, where alternative procedures (e.g., alternate procedures for conversion of data to units of applicable regulations) can be shown by the State to be equivalent to the procedures set forth in Appendix P of these regulations, then such alternate procedures may be submitted by the State for approval by EPA. Section 3.9 of Appendix P identifies certain examples where alternative emission monitoring systems or alternative procedures will generally be considered by the Agency for approval.

It should be noted that some sources may be unable to comply with the regulations because of technical difficulties, (e.g., the presence of condensed water vapor in the flue gas), physical limitations of accessibility at the plant facility, or, in other cases, because of extreme economic hardship. States should use their judgment in implementing these requirements in such cases. Section 6 of Appendix P of this Part provides various examples where the installation of continuous emission monitors would not be feasible or reasonable. In such cases alternate emission monitoring (and reporting) by more routine methods, such as manual stack testing, must be required. States in preparing their revised SIP must set forth and describe the criteria they will use to identify such unusual cases, and must further describe the alternative procedures they will implement to otherwise satisfy the intent of these regulations. States are advised that this provision is intended for unusual cases, and, as such, should not be widely applied.

It was pointed out by some commentors that carbon dioxide monitors could probably be used in lieu of oxygen monitors to provide information to convert emission data to the units of the applicable State regulation. Detailed discussion of the technical merits and limitations of this approach is discussed in the Preamble to the Part 60 Regulations. As pointed out in that Preamble, such monitors may be used in certain situations. Modifications have therefore been made to the Part 51 regulations to allow the use of such monitors which include references to technical specifications contained in Part 60 for carbon dioxide monitors. Also, the cycling time for oxygen monitors has been changed from one hour to 15 minutes to correspond to the specification in Part 60. The difference between cycling times in the two proposals was an oversight. The cycling time for carbon dioxide monitors will also be 15 minutes as in Part 60.

A number of other miscellaneous technical comments were also received. Commentors indicated that the proposed exemption for opacity monitoring requirements that may be granted to oil-fired and gas-fired steam generators should also apply to units burning a combination of these fuels. The Administrator concurs with this suggestion and an exemption for such sources burning oil and gas has ben provided in the final regulations subject to the same restrictions as are imposed on oil-fired steam generators.

As previously indicated, the regulations for emission monitoring for existing sources refer in many cases to the specific performance specifications set forth in the emission monitoring regulations for new sources affected by Part 60. Many of the comments received on the proposed regulations in effect pointed to issues affecting both proposals. In many cases, more specific technical issues are discussed in the Preamble to the Part 60 Regulations and as such the reader is referred to that Preamble. Specifically, the Part 60 Preamble addresses the following topics: data handling and reporting techniques; requirements for reporting repairs and replacement parts used; location of monitoring instruments; changes to span requirements, operating frequency requirements, sulfuric acid and nitric acid plant conversion factors; and, for opacity monitoring equipment, changes in the cycling time and in alignment procedures. The reader is cautioned, however, that specific reference to regulations in the Part 60 Preamble is strictly to federal New Source Performance Regulations rather than State and local control agency regulations which affect existing sources and which are part of an applicable plan.

In addition to the many technical comments received, a number of legal issues were raised. Several commentors questioned EPA's statutory authority to promulgate these regulations and pointed out other alleged legal defects in the proposal. The Administrator has considered these comments, and has found them unpersuasive.

One commentor argued that new 40 CFR 51.19(e) will require "revisions" to existing state plans; that "revisions" may be called for under Section 110(a) (2(H) of the Clean Air Act only where EPA has found that there are "improved or more expeditious methods" for achieving ambient standards or that a state plan is "substantially inadequate" to achieve the standards; that the new regulation is based upon neither of these findings; and that therefore there is no statutory authority for the regulation. This argument fails to take cognizance of Section 110(a) (2) (F) (ii) of the Act, which mandates that all state implementation plans contain self-monitoring requirements. The fact that EPA originally accepted plans without these requirements because of substantial uncertainty as to the reliability of self-monitoring equipment does not negate the mandate of the statute.

In essence, new § 51.19(e) does not call for "revisions" as contemplated by the Act, but for supplements to the original plans to make them complete. At any rate, it is the Administrator's judgment that the new self-monitoring requirements *will* result in a "more expeditious" achievement of the ambient standards. Since these requirements are valuable enforcement tools and indicators of malfunctions, they should lead to a net decrease in emissions.

Other commentors argued that even if EPA has statutory authority to require self-monitoring, it has no authority to impose specific minimum requirements for state plans, to require "continuous" monitoring, or to require monitoring of oxygen, which is not a pollutant. These comments fail to consider that a basic precept of administrative law is that an agency may fill in the broad directives of legislation with precise regulatory requirements. More specifically, the Administrator has authority under Section 301(a) of the Clean Air Act to promulgate "such regulations as are necessary to carry out his functions under the Act". Courts have long upheld the authority of agencies to promulgate more specific requirements than are set forth in enabling legislation, so long as the requirements are reasonably related to the purposes of the legislation. Since the Act requires self-monitoring without further guidance, EPA surely has the authority to set specific requirements in order to carry out its function of assuring that the Act is properly implemented.

In EPA's judgment, the requirements set forth in § 51.19(e) are necessary to assure that each state's self-monitoring program is sufficient to comply with the Act's mandate. The fact that oxygen and carbon dioxide are not air pollutants controlled under the Act is legally irrelevant, since in EPA's judgment, they must be monitored in order to convert measured emission data to units of emission standards.

Other commentors have argued that the self-monitoring requirements violate the protection against self-incrimination provided in the Fifth Amendment to the U.S. Constitution, and that the information obtained from the monitoring is so unreliable as to be invalid evidence for use in court.

There are two reasons why the self-incrimination argument is invalid. First, the self-incrimination privilege does not apply to corporations, and it is probable that a great majority of the sources covered by these requirements will be owned by corporations. Secondly, courts have continually recognized an exception to the privilege for "records required by law", such as the self-monitoring and reporting procedures which are required by the Clean Air Act. As to the validity of evidence issue, in EPA's opinion, the required performance specifications will assure that self-monitoring equipment will be sufficiently reliable to withstand attacks in court.

Finally, some comments reflected a misunderstanding of EPA's suggestion that states explore with counsel ways to draft their regulations so as to automatically incorporate by reference future additions to Appendix P and avoid the time-consuming plan revision process. (EPA pointed out that public participation would still be assured, since EPA's proposed revisions to Appendix P would always be subject to public comment on a nation-wide basis.)

EPA's purpose was merely to *suggest* an approach that a state may wish to follow *if* the approach would be legal under that state's law. EPA offers no opinion as to whether any state law would allow this. Such a determination is up to the individual states.

Summary of Revisions and Clarifications to the Proposed Regulations. Briefly, the revisions and clarifications to the proposed regulations include:

(1) A clarification to indicate that continuous emission monitors are not required for sources unless such sources are subject to an applicable emission limitation of an approved SIP.

(2) A revision to require emission monitors for oxides of nitrogen in only those AQCR's where the Administrator has specifically called for a control strategy for nitrogen dioxide.

(3) A revision to include a general provision to exempt any source that clearly demonstrates that it will cease operation within five years of the inclusion of monitoring requirements for the source in Appendix P.

(4) Revisions to exempt smaller-sized sources and infrequently used sources within the specified source categories.

(5) A revision to the data reporting requirements to require the submittal by the source of the State, emission data in excess of the applicable emission limitation for both opacity and gaseous pollutants, rather than all measured data, as proposed. A provision has been added to require information on the cause of all noted violations of applicable regulations.

(6) A clarification to indicate that the continuous monitoring of oxygen is not required unless the continuous monitoring of sulfur dioxide and/or nitrogen oxides emissions is required by the applicable SIP.

(7) A revision to allow the placement of continuous emission monitors at "a representative location" on the exhaust gas system rather than at "the most representative location" as required by the proposed regulations.

(8) A revision to delete the requirements of new performance tests each time the continuous monitoring equipment is repaired or modified. However, a new provision is included to require that a report of all repairs and maintenance performed during the quarter shall be reported by the source to the State.

(9) A modification to provide sources 18 months rather than one year after approval or promulgation of the revised SIP to comply with the continuous monitoring regulations adopted by the States.

(10) A modification to provide States one year, rather than the six months after the promulgation of these regulations in the FEDERAL REGISTER to submit plan revisions to satisfy the requirements promulgated herein.

Requirements of States. States shall be required to revise their SIP's by October 6, 1976 to include legally enforceable procedures to require emission monitoring, recording and reporting, as a minimum for those sources specified in the regulations promulgated herein. While minimum requirements have been established, States may, as they deem appropriate, expand these requirements.

The regulations promulgated herein have been revised in light of the various comments to generally provide a more limited introduction into this new methodology. Cooperation among affected parties, i.e., State and local control agencies, sources, instrument manufacturers and suppliers, and this Agency is necessary to move successfully forward in these areas of emission monitoring and reporting prescribed in the Clean Air Act. Assistance can be obtained from the EPA Regional Offices in relation to the technical and procedural aspects of these regulations.

Copies of documents referenced in this Preamble are available for public inspection at the EPA Freedom of Information Center, 401 M Street, S.W., Washington, D.C. 20460. The Agency has not prepared an environmental impact statement for these regulations since they were proposed (September 11, 1974) prior to the effective date for requiring voluntary environmental impact statements on EPA's regulatory actions (see 39 FR 16186, May 7, 1974).

The regulations set forth below are promulgated under the authority of sections 110(a)(2)(F)(ii)-(iii) and 301(a) of the Clean Air Act, as amended [42 U.S.C. 1857c-5(a)(2)(F)(ii)-(iii), 1857g(a)] and are effective November 5, 1975.

Dated: September 23, 1975.

JOHN QUARLES,
Acting Administrator.

REFERENCES

1. Jenkins, R. E., Strategies and Air Standards Division, OAQPS, EPA. Memo to R. L. Ajax, Emission Standards and Engineering Division, OAQPS, EPA, Emission Monitoring Costs. February 27, 1975.

2. Young, D. E., Control Programs Development Division, OAQPS, EPA. Memo to E. J. Lillis, Control Programs Development Division, OAQPS, EPA, Emission Source Data for In-Stack Monitoring Regulations. June 4, 1975.

1. Section 51.1 is amended by adding paragraphs (z), (aa), (bb), (cc), (dd), and (ee) as follows:

§ 51.1 Definitions.

* * * * *

(z) "Emission standard" means a regulation (or portion thereof) setting forth an allowable rate of emissions, level of opacity, or prescribing equipment or fuel specifications that result in control of air pollution emissions.

(aa) "Capacity factor" means the ratio of the average load on a machine or equipment for the period of time considered to the capacity rating of the machine or equipment.

(bb) "Excess emissions" means emissions of an air pollutant in excess of an emission standard.

(cc) "Nitric acid plant" means any facility producing nitric acid 30 to 70 percent in strength by either the pressure or atmospheric pressure process.

(dd) "Sulfuric acid plant" means any facility producing sulfuric acid by the contact process by burning elemental sulfur, alkylation acid, hydrogen sulfide, or acid sludge, but does not include facilities where conversion to sulfuric acid is utilized primarily as a means of preventing emissions to the atmosphere of sulfur dioxide or other sulfur compounds.

(ee) "Fossil fuel-fired steam generator" means a furnace or boiler used in the process of burning fossil fuel for the primary purpose of producing steam by heat transfer.

2. Section 51.19 is amended by adding paragraph (e) as follows:

§ 51.19 Source surveillance.

* * * * *

(e) Legally enforceable procedures to require stationary sources subject to emission standards as part of an applicable plan to install, calibrate, maintain, and operate equipment for continuously monitoring and recording emissions; and to provide other information as specified in Appendix P of this part.

(1) Such procedures shall identify the types of sources, by source category and capacity, that must install such instruments, and shall identify for each source category the pollutants which must be monitored.

(2) Such procedures shall, as a minimum, require the types of sources set forth in Appendix P of this part (as such appendix may be amended from time to time) to meet the applicable requirements set forth therein.

(3) Such procedures shall contain provisions which require the owner or operator of each source subject to continuous emission monitoring and recording requirements to maintain a file of all pertinent information. Such information shall include emission measurements, continuous monitoring system performance testing measurements, performance evaluations, calibration checks, and adjustments and maintenance performed on such monitoring systems and other reports and records required by Appendix P of this Part for at least two years following the date of such measurements or maintenance.

(4) Such procedures shall require the source owner or operator to submit information relating to emissions and operation of the emission monitors to the State to the extent described in Appendix P as frequently or more frequently as described therein.

(5) Such procedures shall provide that sources subject to the requirements of § 51.19(e)(2) of this section shall have installed all necessary equipment and shall have begun monitoring and recording within 18 months of (1) the approval of a State plan requiring monitoring for that source or (2) promulgation by the Agency of monitoring requirements for that source. However, sources that have made good faith efforts to purchase, install, and begin the monitoring and recording of emission data but who have been unable to complete such installation within the time period provided may be given reasonable extensions of time as deemed appropriate by the State.

(6) States shall submit revisions to the applicable plan which implement the provisions of this section by October 6, 1976.

3. In Part 51, Appendix P is added as follows:

* * * * *

APPENDIX P—MINIMUM EMISSION MONITORING REQUIREMENTS

1.0 Purpose. This Appendix P sets forth the minimum requirements for continuous emission monitoring and recording that each State Implementation Plan must include in order to be approved under the provisions of 40 CFR 51.19(e). These requirements include the source categories to be affected; emission monitoring, recording, and reporting requirements for these sources; performance specifications for accuracy, reliability, and durability of acceptable monitoring systems; and techniques to convert emission data to units of the applicable State emission standard. Such data must be reported to the State as an indication of whether proper maintenance and operating procedures are being utilized by source operators to maintain emission levels at or below emission standards. Such data may be used directly or indirectly for compliance determination or any other purpose deemed appropriate by the State. Though the monitoring requirements are specified in detail, States are given some flexibility to resolve difficulties that may arise during the implementation of these regulations.

1.1 *Applicability.*

The State plan shall require the owner or operator of an emission source in a category listed in this Appendix to: (1) install, calibrate, operate, and maintain all monitoring equipment necessary for continuously monitoring the pollutants specified in this Appendix for the applicable source category; and (2) complete the installation and performance tests of such equipment and begin monitoring and recording within 18 months of plan approval or promulgation. The source categories and the respective monitoring requirements are listed below.

1.1.1 Fossil fuel-fired steam generators, as specified in paragraph 2.1 of this appendix, shall be monitored for opacity, nitrogen oxides emissions, sulfur dioxide emissions, and oxygen or carbon dioxide.

1.1.2 Fluid bed catalytic cracking unit catalyst regenerators, as specified in paragraph 2.4 of this appendix, shall be monitored for opacity.

1.1.3 Sulfuric acid plants, as specified in paragraph 2.3 of this appendix, shall be monitored for sulfur dioxide emissions.

1.1.4 Nitric acid plants, as specified in paragraph 2.2 of this appendix, shall be monitored for nitrogen oxides emissions.

1.2 *Exemptions.*

The States may include provisions within their regulations to grant exemptions from the monitoring requirements of paragraph 1.1 of this appendix for any source which is:

1.2.1 subject to a new source performance standard promulgated in 40 CFR Part 60 pursuant to Section 111 of the Clean Air Act; or

1.2.2 not subject to an applicable emission standard of an approved plan; or

1.2.3 scheduled for retirement within 5 years after inclusion of monitoring requirements for the source in Appendix P, provided that adequate evidence and guarantees are provided that clearly show that the source will cease operations prior to such date.

1.3 *Extensions.*

States may allow reasonable extensions of the time provided for installation of monitors for facilities unable to meet the prescribed timeframe (i.e., 18 months from plan approval or promulgation) provided the owner or operator of such facility demonstrates that good faith efforts have been made to obtain and install such devices within such prescribed timeframe.

1.4 *Monitoring System Malfunction.*

The State plan may provide a temporary exemption from the monitoring and reporting requirements of this appendix during any period of monitoring system malfunction, provided that the source owner or operator shows, to the satisfaction of the State, that the malfunction was unavoidable and is being repaired as expeditiously as practicable.

2.0 *Minimum Monitoring Requirement.*

States must, as a minimum, require the sources listed in paragraph 1.1 of this appendix to meet the following basic requirements

2.1 *Fossil fuel-fired steam generators.*

Each fossil fuel-fired steam generator, except as provided in the following subparagraphs, with an annual average capacity factor of greater than 30 percent, as reported to the Federal Power Commission for calendar year 1974, or as otherwise demonstrated to the State by the owner or operator, shall conform with the following monitoring requirements when such facility is subject to an emission standard of an applicable plan for the pollutant in question.

2.1.1 A continuous monitoring system for the measurement of opacity which meets the performance specifications of paragraph 3.1.1 of this appendix shall be installed, calibrated, maintained, and operated in accordance with the procedures of this appendix by the owner or operator of any such steam generator of greater than 250 million BTU per hour heat input except where:

2.1.1.1 gaseous fuel is the only fuel burned, or

2.1.1.2 oil or a mixture of gas and oil are the only fuels burned and the source is able to comply with the applicable particulate matter and opacity regulations without utilization of particulate matter collection equipment, and where the source has never been found, through any administrative or judicial proceedings, to be in violation of any visible emission standard of the applicable plan.

2.1.2 A continuous monitoring system for the measurement of sulfur dioxide which meets the performance specifications of paragraph 3.1.3 of this appendix shall be installed, calibrated, maintained, and operated on any fossil fuel-fired steam generator of greater than 250 million BTU per hour heat input which has installed sulfur dioxide pollutant control equipment.

2.1.3 A continuous monitoring system for the measurement of nitrogen oxides which meets the performance specification of paragraph 3.1.2 of this appendix shall be installed, calibrated, maintained, and operated on fossil fuel-fired steam generators of greater than 1000 million BTU per hour heat input when such facility is located in an Air Quality Control Region where the Administrator has specifically determined that a control strategy for nitrogen dioxide is necessary to attain the national standards, unless the source owner or operator demonstrates during source compliance tests as required by the State that such a source emits nitrogen oxides at levels 30 percent or more below the emission standard within the applicable plan.

2.1.4 A continuous monitoring system for the measurement of the percent oxygen or carbon dioxide which meets the performance specifications of paragraphs 3.1.4 or 3.1.5 of this appendix shall be installed, calibrated, operated, and maintained on fossil fuel-fired steam generators where measurements of oxygen or carbon dioxide in the flue gas are required to convert either sulfur dioxide or nitrogen oxides continuous emission monitoring data, or both, to units of the emission standard within the applicable plan.

2.2 *Nitric acid plants.*

Each nitric acid plant of greater than 300 tons per day production capacity, the production capacity being expressed as 100 percent acid, located in an Air Quality Control Region where the Administrator has specifically determined that a control strategy for nitrogen dioxide is necessary to attain the national standard shall install, calibrate, maintain, and operate a continuous monitoring system for the measurement of nitrogen oxides which meets the performance specifications of paragraph 3.1.2 for each nitric acid producing facility within such plant.

2.3 *Sulfuric acid plants.*

Each Sulfuric acid plant of greater than 300 tons per day production capacity, the production being expressed as 100 percent acid, shall install, calibrate, maintain and operate a continuous monitoring system for the measurement of sulfur dioxide which meets the performance specifications of 3.1.3 for each sulfuric acid producing facility within such plant.

2.4 *Fluid bed catalytic cracking unit catalyst regenerators at petroleum refineries.*

Each catalyst regenerator for fluid bed catalytic cracking units of greater than 20,000 barrels per day fresh feed capacity shall install, calibrate, maintain, and operate a continuous monitoring system for the measurement of opacity which meets the performance specifications of 3.1.1.

3.0 *Minimum specifications.*

All State plans shall require owners or operators of monitoring equipment installed to comply with this Appendix, except as provided in paragraph 3.2, to demonstrate compliance with the following performance specifications.

3.1 *Performance specifications.*

The performance specifications set forth in Appendix B of Part 60 are incorporated herein by reference, and shall be used by States to determine acceptability of monitoring equipment installed pursuant to this Appendix except that (1) where reference is made to the "Administrator" in Appendix B, Part 60, the term "State" should be inserted for the purpose of this Appendix (e.g., in Performance Specification 1, 1.2, ". . . monitoring systems subject to approval by the *Administrator,*" should be interpreted as, ". . . monitoring systems subject to approval by the *State*"), and (2) where reference is made to the "Reference Method" in Appendix B, Part 60, the State may allow the use of either the State approved reference method or the Federally approved reference method as published in Part 60 of this Chapter. The Performance Specifications to be used with each type of monitoring system are listed below.

3.1.1 Continuous monitoring systems for measuring opacity shall comply with Performance Specification 1.

3.1.2 Continuous monitoring systems for measuring nitrogen oxides shall comply with Performance Specification 2.

3.1.3 Continuous monitoring systems for measuring sulfur dioxide shall comply with Performance Specification 2.

3.1.4 Continuous monitoring systems for measuring oxygen shall comply with Performance Specification 3.

3.1.5 Continuous monitoring systems for measuring carbon dioxide shall comply with Performance Specification 3.

3.2 *Exemptions.*

Any source which has purchased an emission monitoring system(s) prior to September 11, 1974, may be exempt from meeting such test procedures prescribed in Appendix B of Part 60 for a period not to exceed five years from plan approval or promulgation.

3.3 *Calibration Gases.*

For nitrogen oxides monitoring systems installed on fossil fuel-fired steam generators the pollutant gas used to prepare calibration gas mixtures (Section 2.1, Performance Specification 2, Appendix B, Part 60) shall be nitric oxide (NO). For nitrogen oxides monitoring systems, installed on nitric acid plants the pollutant gas used to prepare calibration gas mixtures (Section 2.1, Performance Specification 2, Appendix B, Part 60 of this Chapter) shall be nitrogen dioxide (NO_2). These gases shall also be used for daily checks under paragraph 3.7 of this appendix as applicable. For sulfur dioxide monitoring systems installed on fossil fuel-fired steam generators or sulfuric acid plants the pollutant gas used to prepare calibration gas mixtures (Section 2.1, Performance Specification 2, Appendix B, Part 60 of this Chapter) shall be sulfur dioxide (SO_2). Span and zero gases should be traceable to National Bureau of Standards reference gases whenever these reference gases are available. Every six months from date of manufacture, span and zero gases shall be reanalyzed by conducting triplicate analyses using the reference methods in Appendix A, Part 60 of this chapter as follows: for sulfur dioxide, use Reference Method 6; for nitrogen oxides, use Reference Method 7; and for carbon dioxide or oxygen, use Reference Method 3. The gases may be analyzed at less frequent intervals if longer shelf lives are guaranteed by the manufacturer.

3.4 *Cycling times.*

Cycling times include the total time a monitoring system requires to sample, analyze and record an emission measurement.

3.4.1 Continuous monitoring systems for measuring opacity shall complete a minimum of one cycle of operation (sampling, analyzing, and data recording) for each successive 10-second period.

3.4.2 Continuous monitoring systems for measuring oxides of nitrogen, carbon dioxide, oxygen, or sulfur dioxide shall complete a minimum of one cycle of operation (sampling, analyzing, and data recording) for each successive 15-minute period.

3.5 *Monitor location.*

State plans shall require all continuous monitoring systems or monitoring devices to be installed such that representative measurements of emissions or process parameters (i.e., oxygen, or carbon dioxide) from the affected facility are obtained. Additional guidance for location of continuous monitoring systems to obtain representative samples are contained in the applicable Performance Specifications of Appendix B of Part 60 of this Chapter.

3.6 *Combined effluents.*

When the effluents from two or more affected facilities of similar design and operating characteristics are combined before being released to the atmosphere, the State plan may allow monitoring systems to be installed on the combined effluent. When the affected facilities are not of similar design and operating characteristics, or when the effluent from one affected facility is released to the atmosphere through more than one point, the State should establish alternate procedures to implement the intent of these requirements.

3.7 *Zero and drift.*

State plans shall require owners or operators of all continuous monitoring systems installed in accordance with the requirements of this Appendix to record the zero and span drift in accordance with the method prescribed by the manufacturer of such instruments; to subject the instruments to the manufacturer's recommended zero and span check at least once daily unless the manufacturer has recommended adjustments at shorter intervals, in which case such recommendations shall be followed; to adjust the zero and span whenever the 24-hour zero drift or 24-hour calibration drift limits of the applicable performance specifications in Appendix B of Part 60 are exceeded; and to adjust continuous monitoring systems referenced by paragraph 3.2 of this Appendix whenever the 24-hour zero drift or 24-hour calibration drift exceed 10 percent of the emission standard.

3.8 *Span.*

Instrument span should be approximately 200 per cent of the expected instrument data display output corresponding to the emission standard for the source.

3.9 *Alternative procedures and requirements.*

In cases where States wish to utilize different, but equivalent, procedures and requirements for continuous monitoring systems, the State plan must provide a description of such alternative proceduers for approval by the Administrator. Some examples of situations that may require alternatives follow:

3.9.1 Alternative monitoring requirements to accommodate continuous monitoring systems that require corrections for stack moisture conditions (e.g., an instrument measuring steam generator SO_2 emissions on a wet basis could be used with an instrument measuring oxygen concentration on a dry basis if acceptable methods of measuring stack moisture conditions are used to allow accurate adjustment of the measured SO_2 concentration to dry basis.)

3.9.2 Alternative locations for installing continuous monitoring systems or monitoring devices when the owner or operator can demonstrate that installation at alternative locations will enable accurate and representative measurements.

3.9.3 Alternative procedures for performing calibration checks (e.g., some instruments may demonstrate superior drift characteristics that require checking at less frequent intervals).

3.9.4 Alternative monitoring requirements when the effluent from one affected facility or the combined effluent from two or more identical affected facilities is released to the atmosphere through more than one point (e.g., an extractive, gaseous monitoring system used at several points may be approved if the procedures recommended are suitable for generating accurate emission averages).

3.9.5 Alternative continuous monitoring systems that do not meet the spectral response requirements in Performance Specification 1, Appendix B of Part 60, but adequately demonstrate a definite and consistent relationship between their measurements and the opacity measurements of a system complying with the requirements in Performance Specification 1. The State may require that such demonstration be performed for each affected facility.

4.0 *Minimum data requirements.*

The following paragraphs set forth the minimum data reporting requirements necessary to comply with § 51.19(e) (3) and (4).

4.1 The State plan shall require owners or operators of facilities required to install continuous monitoring systems to submit a written report of excess emissions for each calendar quarter and the nature and cause of the excess emissions, if known. The averaging period used for data reporting should be established by the State to correspond to the averaging period specified in the emission test method used to determine compliance with an emission standard for the pollutant/source category in question. The required report shall include, as a minimum, the data stipulated in this Appendix.

4.2 For opacity measurements, the summary shall consist of the magnitude in actual percent opacity of all one-minute (or such other time period deemed appropriate by the State) averages of opacity greater than the opacity standard in the applicable plan for each hour of operation of the facility. Average values may be obtained by integration over the averaging period or by arithmetically averaging a minimum of four equally spaced, instantaneous opacity measurements per minute. Any time period exempted shall be considered before determining the excess averages of opacity (e.g., whenever a regulation allows two minutes of opacity measurements in excess of the standard, the State shall require the source to report all opacity averages, in any one hour, in excess of the standard, minus the two-minute exemption). If more than one opacity standard applies, excess emissions data must be submitted in relation to all such standards.

4.3 For gaseous measurements the summary shall consist of emission averages, in the units of the applicable standard, for each averaging period during which the applicable standard was exceeded.

4.4 The date and time identifying each period during which the continuous monitoring system was inoperative, except for zero and span checks, and the nature of system repairs or adjustments shall be reported. The State may require proof of continuous monitoring system performance whenever system repairs or adjustments have been made.

4.5 When no excess emissions have occurred and the continuous monitoring system(s) have not been inoperative, repaired, or adjusted, such information shall be included in the report.

4.6 The State plan shall require owners or operators of affected facilities to maintain a file of all information reported in the quarterly summaries, and all other data collected either by the continuous monitoring system or as necessary to convert monitoring data to the units of the applicable standard for a minimum of two years from the date of collection of such data or submission of such summaries.

5.0 *Data Reduction.*

The State plan shall require owners or operators of affected facilities to use the following procedures for converting monitoring data to units of the standard where necessary.

5.1 For fossil fuel-fired steam generators the following procedures shall be used to convert gaseous emission monitoring data in parts per million to g/million cal (lb/million BTU) where necessary:

5.1.1 When the owner or operator of a fossil fuel-fired steam generator elects under subparagraph 2.1.4 of this Appendix to measure oxygen in the flue gases, the measurements of the pollutant concentration and oxygen concentration shall each be on a dry basis and the following conversion procedure used:

$$E = CF\left(\frac{20.9}{20.9 - \%O_2}\right)$$

5.1.2 When the owner or operator elects under subparagraph 2.1.4 of this Appendix to measure carbon dioxide in the flue gases, the measurement of the pollutant concentration and the carbon dioxide concentration shall each be on a consistent basis (wet or dry) and the following conversion procedure used:

$$E = CF_c\left(\frac{100}{\%\,CO_2}\right)$$

5.1.3 The values used in the equations under paragraph 5.1 are derived as follows:

E = pollutant emission, g/million cal (lb/million BTU).

C = pollutant concentration, g/dscm (lb/dscf), determined by multiplying the average concentration (ppm) for each hourly period by 4.16×10^{-5} M g/dscm per ppm (2.64×10^{-9} M lb/dscf per ppm) where M = pollutant molecular weight, g/g-mole (lb/lb-mole). M = 64 for sulfur dioxide and 46 for oxides of nitrogen.

$\%O_2$, $\%CO_2$ = Oxygen or carbon dioxide volume (expressed as percent) determined with equipment specified under paragraph 4.1.4 of this appendix.

F, F_c = a factor representing a ratio of the volume of dry flue gases generated to the calorific value of the fuel combusted (F), and a factor representing a ratio of the volume of carbon dioxide generated to the calorific value of the fuel combusted (F_c) respectively. Values of F and F_c are given in § 60.45(f) of Part 60, as applicable.

5.2 For sulfuric acid plants the owner or operator shall;

5.2.1 establish a conversion factor three times daily according to the procedures to § 60.84(b) of this chapter;

5.2.2 multiply the conversion factor by the average sulfur dioxide concentration in the flue gases to obtain average sulfur dioxide emissions in Kg/metric ton (lb/short ton); and

5.2.3 report the average sulfur dioxide emission for each averaging period in excess of the applicable emission standard in the quarterly summary.

5.3 For nitric acid plants the owner or operator shall;

5.3.1 establish a conversion factor according to the procedures of § 60.73(b) of this chapter.

5.3.2 multiply the conversion factor by the average nitrogen oxides concentration in the flue gases to obtain the nitrogen oxides emissions in the units of the applicable standard;

5.3.3 report the average nitrogen oxides emission for each averaging period in excess of the applicable emission standard, in the quarterly summary.

5.4 Any State may allow data reporting or reduction procedures varying from those set forth in this Appendix if the owner or operator of a source shows to the satisfaction of the State that his procedures are at least as accurate as those in this Appendix. Such procedures may include but are not limited to, the following:

5.4.1 Alternative procedures for computing emission averages that do not require integration of data (e.g., some facilities may demonstrate that the variability of their emissions is sufficiently small to allow accurate reduction of data based upon computing averages from equally spaced data points over the averaging period).

5.4.2 Alternative methods of converting pollutant concentration measurements to the units of the emission standards.

6.0 *Special Consideration.*

The State plan may provide for approval, on a case-by-case basis, of alternative monitoring requirements different from the provisions of Parts 1 through 5 of this Appendix if the provisions of this Appendix (i.e., the installation of a continuous emission monitoring system) cannot be implemented by a source due to physical plant limitations or extreme economic reasons. To make use of this provision, States must include in their plan specific criteria for determining those physical limitations or extreme economic situations to be considered by the State. In such cases, when the State exempts any source subject to this Appendix by use of this provision from installing continuous emission monitoring systems, the State shall set forth alternative emission monitoring and reporting requirements (e.g., periodic manual stack tests) to satisfy the intent of these regulations. Examples of such special cases include, but are not limited to, the following:

6.1 Alternative monitoring requirements may be prescribed when installation of a continuous monitoring system or monitoring device specified by this Appendix would not provide accurate determinations of emissions (e.g., condensed, uncombined water vapor may prevent an accurate determination of opacity using commercially available continuous monitoring systems).

6.2 Alternative monitoring requirements may be prescribed when the affected facility is infrequently operated (e.g., some affected facilities may operate less than one month per year).

6.3 Alternative monitoring requirements may be prescribed when the State determines that the requirements of this Appendix would impose an extreme economic burden on the source owner or operator.

6.4 Alternative monitoring requirements may be prescribed when the State determines that monitoring systems prescribed by this Appendix cannot be installed due to physical limitations at the facility.

[FR Doc.75-26566 Filed 10-3-75;8:45 am]

ENVIRONMENTAL PROTECTION AGENCY

NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS

Subpart F—National Emission Standard for Vinyl Chloride

§ 61.60 Applicability.

(a) This subpart applies to plants which produce:

(1) Ethylene dichloride by reaction of oxygen and hydrogen chloride with ethylene,

(2) Vinyl chloride by any process, and/or

(3) One or more polymers containing any fraction of polymerized vinyl chloride.

(b) This subpart does not apply to equipment used in research and development if the reactor used to polymerize the vinyl chloride processed in the equipment has a capacity of no more than 0.19 m^3 (50 gal).

(c) Sections of this subpart other than §§ 61.61; 61.64 (a)(1), (b), (c), and (d); 61.67; 61.68; 61.69; 61.70; and 61.71 do not apply to equipment used in research and development if the reactor used to polymerize the vinyl chloride processed in the equipment has a capacity of greater than 0.19 m^3 (50 gal) and no more than 4.07 m^3 (1100 gal).

§ 61.61 Definitions.

Terms used in this subpart are defined in the Act, in subpart A of this part, or in this section as follows:

(a) "Ethylene dichloride plant" includes any plant which produces ethylene dichloride by reaction of oxygen and hydrogen chloride with ethylene.

(b) "Vinyl chloride plant" includes any plant which produces vinyl chloride by any process.

(c) "Polyvinyl chloride plant" includes any plant where vinyl chloride alone or in combination with other materials is polymerized.

(d) "Slip gauge" means a gauge which has a probe that moves through the gas/liquid interface in a storage or transfer vessel and indicates the level of vinyl chloride in the vessel by the physical state of the material the gauge discharges.

(e) "Type of resin" means the broad classification of resin referring to the basic manufacturing process for producing that resin, including, but not limited to, the suspension, dispersion, latex, bulk, and solution processes.

(f) "Grade of resin" means the subdivision of resin classification which describes it as a unique resin, i.e., the most exact description of a resin with no further subdivision.

(g) "Dispersion resin" means a resin manufactured in such away as to form fluid dispersions when dispersed in a plasticizer or plasticizer/diluent mixtures.

(h) "Latex resin" means a resin which is produced by a polymerization process which initiates from free radical catalyst sites and is sold undried.

(i) "Bulk resin' 'means a resin which is produced by a polymerization process in which no water is used.

(j) "Inprocess wastewater" means any water which, during manufacturing or processing, comes into direct contact with vinyl chloride or polyvinyl chloride or results from the production or use of any raw material, intermediate product, finished product, by-product, or waste product containing vinyl chloride or polyvinyl chloride but which has not been discharged to a wastewater treatment process or discharged untreated as wastewater.

(k) "Wastewater treatment process" includes any process which modifies characteristics such as BOD, COD, TSS, and pH, usually for the purpose of meeting effluent guidelines and standards; it does not include any process the purpose of which is to remove vinyl chloride from water to meet requirements of this subpart.

(l) "In vinyl chloride service" means that a piece of equipment contains or contacts either a liquid that is at least 10 percent by weight vinyl chloride or a gas that is at least 10 percent by volume vinyl chloride.

(m) "Standard operating procedure" means a formal written procedure officially adopted by the plant owner or operator and available on a routine basis to those persons responsible for carrying out the procedure.

(n) "Run" means the net period of time during which an emission sample is collected.

(o) "Ethylene dichloride purification" includes any part of the process of ethylene dichloride production which follows ethylene dichloride formation and in which finished ethylene dichloride is produced.

(p) "Vinyl chloride purification" includes any part of the process of vinyl chloride production which follows vinyl chloride formation and in which finished vinyl chloride is produced.

(q) "Reactor" includes any vessel in which vinyl chloride is partially or totally polymerized into polyvinyl chloride.

(r) "Reactor opening loss" means the emissions of vinyl chloride occurring when a reactor is vented to the atmosphere for any purpose other than an emergency relief discharge as defined in § 61.65(a).

(s) "Stripper" includes any vessel in which residual vinyl chloride is removed from polyvinyl chloride resin, except bulk resin, in the slurry form by the use of heat and/or vacuum. In the case of bulk resin, stripper includes any vessel which is used to remove residual vinyl chloride from polyvinyl chloride resin immediately following the polymerization step in the plant process flow.

(t) "Standard temperature" means a temperature of 20° C (69° F).

(u) "Standard pressure" means a pressure of 760 mm of Hg (29.92 in. of Hg).

§ 61.62 Emission standard for ethylene dichloride plants.

(a) Ethylene dichloride purification: The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from any equipment used in ethylene dichloride purification is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that has been opened, is out of operation, and met the requirement in § 61.65(b)(6)(i) before being opened.

(b) Oxychlorination reactor: Except as provided in § 61.65(a), emissions of vinyl chloride to the atmosphere from each oxychlorination reactor are not to exceed 0.2 g/kg (0.0002 lb/lb) of the 100 percent ethylene dichloride product from the oxychlorination process.

§ 61.63 Emission standard for vinyl chloride plants.

An owner or operator of a vinyl chloride plant shall comply with the requirements of this section and § 61.65.

(a) Vinyl chloride formation and purification: The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from any equipment used in vinyl chloride formation and/or purification is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that has been opened, is out of operation, and met the requirement in § 61.65(b)(6)(i) before being opened.

§ 61.64 Emission standard for polyvinyl chloride plants.

An owner or operator of a polyvinyl chloride plant shall comply with the requirements of this section and § 61.65.

(a) Reactor: The following requirements apply to reactors:

(1) The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each reactor is not to exceed 10 ppm, except as provided in paragraph (a)(2) of this section and § 61.65(a).

(2) The reactor opening loss from each reactor is not to exceed 0.02 g vinyl chloride/Kg (0.00002 lb vinyl chloride/lb) of polyvinyl chloride product, with the product determined on a dry solids basis. This requirement applies to any vessel which is used as a reactor or as both a reactor and a stripper. In the bulk process, the product means the gross product of prepolymerization and postpolymerization.

(3) Manual vent valve discharge: Except for an emergency manual vent valve discharge, there is to be no discharge to the atmosphere from any manual vent valve on a polyvinyl chloride reactor in vinyl chloride service. An emergency manual vent valve discharge means a discharge to the atmosphere which could not have been avoided by taking measures to prevent the discharge. Within 10 days of any discharge to the atmosphere from any manual vent valve, the owner or operator of the source from which the discharge occurs shall submit to the Administrator a report in writing containing information on the source, nature and cause of the discharge, the date and time of the discharge, the approximate total vinyl chloride loss during the discharge, the method used for determining the vinyl chloride loss, the action that was taken to prevent the discharge, and measures adopted to prevent future discharges.

(b) Stripper: The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each stripper is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that has been opened, is out of operation, and met the requirement in § 61.65(b)(6)(i) before being opened.

(c) Mixing, weighing, and holding containers: The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each mixing, weighing, or holding container in vinyl chloride service which precedes the stripper (or the reactor if the plant has no stripper) in the plant process flow is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that has been opened, is out of operation, and met the requirement in § 61.65(b)(6)(i) before being opened.

(d) Monomer recovery system. The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each monomer recovery system is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that has been opened, is out of operation, and met the requirement in § 61.65(b)(6)(i) before being opened.

(e) Sources following the stripper(s): The following requirements apply to emissions of vinyl chloride to the atmosphere from the combination of all sources following the stripper(s) [or the reactor(s) if the plant has no stripper(s)] in the plant process flow including but not limited to, centrifuges, concentrators, blend tanks, filters, dryers, conveyor air discharges, baggers, storage containers, and inprocess wastewater:

(1) In polyvinyl chloride plants using stripping technology to control vinyl chloride emissions, the weighted average residual vinyl chloride concentration in all grades of polyvinyl chloride resin processed through the stripping operation on each calendar day, measured immediately after the stripping operation is completed, may not exceed:

(i) 2000 ppm for polyvinyl chloride dispersion resins, excluding latex resins;

(ii) 400 ppm for all other polyvinyl chloride resins, including latex resins, averaged separately for each type of resin; or

(2) In polyvinyl chloride plants controlling vinyl chloride emissions with technology other than stripping or in addition to stripping, emissions of vinyl chloride to the atmosphere may not exceed:

(i) 2 g/kg (0.002 lb/lb) product from the stripper(s) [or reactor(s) if the plant has no stripper(s)] for dispersion polyvinyl chloride resins, excluding latex resins, with the product determined on a dry solids basis;

(ii) 0.4 g/kg (0.0004 lb/lb) product from the strippers [or reactor(s) if the plant has no stripper(s)] for all other polyvinyl chloride resins, including latex resins, with the product determined on a dry solids basis.

§ 61.65 Emission standard for ethylene dichloride, vinyl chloride and polyvinyl chloride plants.

An owner or operator of an ethylene dichloride, vinyl chloride, and/or polyvinyl chloride plant shall comply with the requirements of this section.

(a) Relief valve discharge: Except for an emergency relief discharge, there is to be no discharge to the atmosphere from any relief valve on any equipment in vinyl chloride service. An emergency relief discharge means a discharge which could not have been avoided by taking measures to prevent the discharge. Within 10 days of any relief valve discharge, the owner or operator of the source from which the relief valve discharge occurs shall submit to the Administrator a report in writing containing information on the source, nature and cause of the discharge, the date and time of the discharge, the approximate total vinyl chloride loss during the discharge, the method used for determining the vinyl chloride loss, the action that was taken to prevent the discharge, and measures adopted to prevent future discharges.

(b) Fugitive emission sources:

(1) Loading and unloading lines: Vinyl chloride emissions from loading and unloading lines in vinyl chloride service which are opened to the atmosphere after each loading or unloading operation are to be minimized as follows:

(i) After each loading or unloading operation and before opening a loading or unloading line to the atmosphere, the quantity of vinyl chloride in all parts of each loading or unloading line that are to be opened to the atmosphere is to be reduced so that the parts combined contain no greater than 0.0038 m^3 (0.13 ft^3) of vinyl chloride, at standard temperature and pressure; and

(ii) Any vinyl chloride removed from a loading or unloading line in accordance with paragraph (b)(1)(i) of this section is to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm, or equivalent as provided in § 61.66.

(2) Slip gauges: During loading or unloading operations, the vinyl chloride emissions from each slip gauge in vinyl chloride service are to be minimized by ducting any vinyl chloride discharged from the slip gauge through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm, or equivalent as provided in § 61.66.

(3) Leakage from pump, compressor, and agitator seals:

(i) Rotating pumps: Vinyl chloride emissions from seals on all rotating pumps in vinyl chloride service are to be minimized by installing sealless pumps, pumps with double mechanical seals, or equivalent as provided in § 61.66. If double mechanical seals are used, vinyl chloride emission from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the pump; by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(ii) Reciprocating pumps: Vinyl chloride emissions from seals on all reciprocating pumps in vinyl chloride service are to be minimized by installing double outboard seals, or equivalent as provided in § 61.66. If double outboard seals are used, vinyl chloride emissions from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the pump; by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(iii) Rotating compressor: Vinyl chloride emissions from seals on all rotating compressors in vinyl chloride service are to be minimized by installing compressors with double mechanical seals, or equivalent as provided in § 61.66. If double mechanical seals are used, vinyl chloride emissions from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the compressor; by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(iv) Reciprocating compressors: Vinyl chloride emissions from seals on all reciprocating compressors in vinyl chloride service are to be minimized by installing double outboard seals, or equivalent as provided in § 61.66. If double outboard seals are used, vinyl chloride emissions from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the compressor; by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(v) Agitator: Vinyl chloride emissions from seals on all agitators in vinyl chloride service are to be minimized by installing agitators with double mechanical seals, or equivalent as provided in § 61.66. If double mechanical seals are used, vinyl chloride emissions from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the agitated vessel; by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(4) Leakage from relief valves: Vinyl chloride emissions due to leakage from each relief valve on equipment in vinyl chloride service are to be minimized by installing a rupture disk between the equipment and the relief valve, by connecting the relief valve discharge to a process line or recovery system, or equivalent as provided in § 61.66.

(5) Manual venting of gases: Except as provided in § 61.64(a)(3), all gases which are manually vented from equipment in vinyl chloride service are to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(6) Opening of equipment: Vinyl chloride emissions from opening of equipment (including loading or unloading lines that are not opened to the atmosphere after each loading or unloading operation) are to be minimized as follows:

(i) Before opening any equipment for any reason, the quantity of vinyl chloride is to be reduced so that the equipment contains no more than 2.0 percent by volume vinyl chloride or 0.0950 m^3 (25 gal) of vinyl chloride, whichever is larger, at standard temperature and pressure; and

(ii) Any vinyl chloride removed from the equipment in accordance with paragraph (b)(6)(i) of this section is to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm, or equivalent as provided in § 61.66.

(7) Samples: Unused portions of samples containing at least 10 percent by weight vinyl chloride are to be returned to the process, and sampling techniques are to be such that sample containers in vinyl chloride service are purged into a closed process system.

(8) Leak detection and elimination: Vinyl chloride emissions due to leaks from equipment in vinyl chloride service are to be minimized by instituting and implementing a formal leak detection and elimination program. The owner or operator shall submit a description of the program to the Administrator for approval. The program is to be submitted within 45 days of the effective date of these regulations, unless a waiver of compliance is granted under § 61.11. If a waiver of compliance is granted, the program is to be submitted on a date scheduled by the Administrator. Approval of a program will be granted by the Administrator provided he finds:

(i) It includes a reliable and accurate vinyl chloride monitoring system for detection of major leaks and identification of the general area of the plant where a leak is located. A vinyl chloride monitoring system means a device which obtains air samples from one or more points on a continuous sequential basis and analyzes the samples with gas chromatography or, if the owner or operator assumes that all hydrocarbons measured are vinyl chloride, with infrared spectrophotometry flame ion detection, or an equivalent or alternative method.

(ii) It includes a reliable and accurate portable hydrocarbon detector to be used routinely to find small leaks and to pinpoint the major leaks indicated by the vinyl chloride monitoring system. A portable hydrocarbon detector means a device which measures hydrocarbons with a sensitivity of at least 10 ppm and is of such design and size that it can be used to measure emissions from localized points.

(iii) It provides for an acceptable calibration and maintenance schedule for the vinyl chloride monitoring system and portable hydrocarbon detector. For the vinyl chloride monitoring system, a daily span check is to be conducted with a concentration of vinyl chloride equal to the concentration defined as a leak according to paragraph (b)(8)(vi) of this section. The calibration is to be done with either:

(A) A calibration gas mixture prepared from the gases specified in sections 5.2.1 and 5.2.2 of Test Method 106 and in accordance with section 7.1 of Test Method 106, or

(B) A calibration gas cylinder standard containing the appropriate concentration of vinyl chloride. The gas composition of the calibration gas cylinder standard is to have been certified by the manufacturer. The manufacturer must have recommended a maximum shelf life for each cylinder so that the concentration does not change greater than ±5 percent from the certified value. The date of gas cylinder preparation, certified vinyl chloride concentration and recommended maximum shelf life must have been affixed to the cylinder before shipment from the manufacturer to the buyer. If a gas chromatograph is used as the vinyl chloride monitoring system, these gas mixtures may be directly used to prepare a chromatograph calibration curve as described in section 7.3 of Test Method 106. The requirements in section 5.2.3.1 and 5.2.3.2 of Test Method 106 for certification of cylinder standards and for establishment and verification of calibration standards are to be followed.

(Secs. 112 and 301(a), Clean Air Act (42 U.S.C. 1857c-7 and 1857g(a)).)

(iv) The location and number of points to be monitored and the frequency of monitoring provided for in the program are acceptable when they are compared with the number of pieces of equipment in vinyl chloride service and the size and physical layout of the plant.

(v) It contains an acceptable plan of action to be taken when a leak is detected.

(vi) It contains a definition of leak which is acceptable when compared with the background concentrations of vinyl chloride in the areas of the plant to be monitored by the vinyl chloride monitoring system. Measurements of background concentrations of vinyl chloride in the areas of the plant to be monitored by the vinyl chloride monitoring system are to be included with the description of the program. The definition of leak for a given plant may vary among the different areas within the plant and is also to change over time as background concentrations in the plant are reduced.

(9) Inprocess wastewater: Vinyl chloride emissions to the atmosphere from inprocess wastewater are to be reduced as follows:

(i) The concentration of vinyl chloride in each inprocess wastewater stream containing greater than 10 ppm vinyl chloride measured immediately as it leaves a piece of equipment and before being mixed with any other inprocess wastewater stream is to be reduced to no more than 10 ppm by weight before being mixed with any other inprocess wastewater stream which contains less than 10 ppm vinyl chloride; before being exposed to the atmosphere, before being discharged to a wastewater treatment process; or before being discharged untreated as a wastewater. This paragraph does apply to water which is used to displace vinyl chloride from equipment before it is opened to the atmosphere in accordance with § 61.64(a)(2) or paragraph (b)(6) of this section, but does not apply to water which is used to wash out equipment after the equipment has already been opened to the atmosphere in accordance with § 61.64(a)(2) or paragraph (b)(6) of this section.

(ii) Any vinyl chloride removed from the inprocess wastewater in accordance with paragraph (b)(9)(i) of this section is to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm, or equivalent as provided in § 61.66.

(c) The requirements in paragraphs (b)(1), (b)(2), (b)(5), (b)(6), (b)(7) and (b)(8) of this section are to be incorporated into a standard operating procedure, anr made available upon request for inspection by the Administrator. The standard operating procedure is to include provisions for measuring the vinyl chloride in equipment ≥4.75 m^3 (1,250 gal) in volume for which an emission limit is prescribed in § 61.65(b)(6)(i) prior to opening the equipment and using Test Method 106, a portable hydrocarbon detector, or an equivalent or alternative method. The method of measurement is to meet the requirements in § 61.67(g)(5)(i)(A) or (g)((5)(i)(B).

§ 61.66 Equivalent equipment and procedures.

Upon written application from an owner or operator, the Administrator may approve use of equipment or procedures which have been demonstrated to his satisfaction to be equivalent in terms of reducing vinyl chloride emissions to the atmosphere to those prescribed for compliance with a specific paragraph of this subpart. For an existing source, any request for using an equivalent method as the initial measure of control is to be submitted to the Administrator within 30 days of the effective date. For a new source, any request for using an equivalent method is to be submitted to the Administrator with the application for approval of construction or modification required by § 61.07.

§ 61.67 Emission tests.

(a) Unless a waiver of emission testing is obtained under § 61.13, the owner or operator of a source to which this subpart applies shall test emissions from the source,

(1) Within 90 days of the effective date in the case of an existing source or a new source which has an initial startup date preceding the effective date, or

(2) Within 90 days of startup in the case of a new source, initial startup of which occurs after the effective date.

(b) The owner or operator shall provide the Administrator at least 30 days prior notice of an emission test to afford the Administrator the opportunity to have an observer present during the test.

(c) Any emission test is to be conducted while the equipment being tested is operating at the maximum production rate at which the equipment will be operated and under other relevant conditions as may be specified by the Administrator based on representative performance of the source.

(d) [Reserved]

(e) When at all possible, each sample is to be analyzed within 24 hours, but in no case in excess of 72 hours of sample collection. Vinyl chloride emissions are to be determined within 30 days after the emission test. The owner or operator shall report the determinations to the Administrator by a registered letter dispatched before the close of the next business day following the determination.

(f) The owner or operator shall retain at the plant and make available, upon request, for inspection by the Administrator, for a minimum of 2 years records of emission test results and other data needed to determine emissions.

(g) Unless otherwise specified, the owner or operator shall use test Test Methods in Appendix B to this part for each test as required by paragraphs (g)(1), (g)(2), (g)(3), (g)(4), and (g)(5) of this section, unless an equivalent method or an alternative method has been approved by the Administrator. If the Administrator finds reasonable grounds to dispute the results obtained by an equivalent or alternative method, he may require the use of a reference method. If the results of the reference and equivalent or alternative methods do not agree, the results obtained by the reference method prevail, and the Administrator may notify the owner or operator that approval of the method previously considered to be equivalent or alternative is withdrawn.

(1) Test Method 106 is to be used to determine the vinyl chloride emissions from any source for which an emission limit is prescribed in §§ 61.62(a) or (b) § 61.63(a), or §§ 61.64(a)(1), (b), (c), or (d), or from any control system to which reactor emissions are required to be ducted in § 61.64(a)(2) or to which fugitive emissions are required to be ducted in §§ 61.65(b)(1)(ii), (b)(2), (b)(5), (b)(6)(ii), or (b)(9)(ii).

(i) For each run, one sample is to be collected. The sampling site is to be at least two stack or duct diameters downstream and one half diameter upstream from any flow disturbance such as a bend, expansion, contraction, or visible flame. For a rectangular cross section an equivalent diameter is to be determined from the following equation:

$$\text{equivalent diameter} = 2\,\frac{(\text{length})\ (\text{width})}{\text{length} + \text{width}}$$

The sampling point in the duct is to be at the centroid of the cross section. The sample is to be extracted at a rate proportional to the gas velocity at the sampling point. The sample is to be taken over a minimum of one hour, and is to contain a minimum volume of 50 liters corrected to standard conditions.

(ii) Each emission test is to consist of three runs. For the purpose of determining emissions, the average of results of all runs is to apply. The average is to be computed on a time weighted basis.

(iii) For gas streams containing more than 10 percent oxygen the concentration of vinyl chloride as determined by Test Method 106 is to be corrected to 10 percent oxygen (dry basis) for determination of emissions by using the following equation:

$$C_{b\,(\text{corrected})} = C_b\,\frac{10.9}{20.9 - \text{percent } O_2}$$

where:

$C_{b\,(\text{corrected})}$ = The concentration of vinyl chloride in the exhaust gases, corrected to 10-percent oxygen.
C_b = The concentration of vinyl chloride as measured by Test Method 106.
20.9 = Percent oxygen in the ambient air at standard conditions.
10.9 = Percent oxygen in the ambient air at standard conditions, minus the 10.0-percent oxygen to which the correction is being made.
Percent O_2 = Percent oxygen in the exhaust gas as measured by Reference Method 3 in Appendix A of Part 60 of this chapter.

(iv) For those emission sources where the emission limit is prescribed in terms of mass rather than concentration, mass emissions in kg/100 kg product are to be determined by using the following equation:

$$C_{BX} = \frac{[C_b\,(2.60)\,Q\,10^{-6}]\,[100]}{Z}$$

where:

C_{BX} = kg vinyl chloride/100 kg product.
C_b = The concentration of vinyl chloride as measured by Test Method 106.
2.60 = Density of vinyl chloride at one atmosphere and 20° C in kg/m^3.
Q = Volumetric flow rate in m^3/hr as determined by Reference Method 2 of Appendix A to Part 60 of this chapter.
10^{-6} = Conversion factor for ppm.
Z = Production rate (kg/hr).

(2) Test Method 107 is to be used to determine the concentration of vinyl chloride in each inprocess wastewater stream for which an emission limit is prescribed in § 61.65(b)(9)(i).

(3) Where a stripping operation is used to attain the emission limit in § 61.64(e), emissions are to be determined using Test Method 107 as follows:

(i) The number of strippers and samples and the types and grades of resin to be sampled are to be determined by the Administrator for each individual plant at the time of the test based on the plant's operation.

(ii) Each sample is to be taken immediately following the stripping operation.

(iii) The corresponding quantity of material processed by each stripper is to be determined on a dry solids basis and by a method submitted to and approved by the Administrator.

(iv) At the prior request of the Administrator, the owner or operator shall provide duplicates of the samples required in paragraph (g)(3)(i) of this section.

(4) Where control technology other than or in addition to a stripping operation is used to attain the emission limit in § 61.64(e), emissions are to be determined as follows:

(i) Test Method 106 is to be used to determine atmospheric emissions from all of the process equipment simultaneously. The requirements of paragraph (g)(1) of this section are to be met.

(ii) Test Method 107 is to be used to determine the concentration of vinyl chloride in each inprocess wastewater stream subject to the emission limit prescribed in § 61.64(e). The mass of vinyl chloride in kg/100 kg product in each in process wastewater stream is to be determined by using the following equation:

$$C_{BX} = \frac{[C_d\,R\,10^{-6}]\,[100]}{Z}$$

where:

C_{BX} = kg vinyl chloride/100 kg product.
C_d = the concentration of vinyl chloride as measured by Test Method 107.
R = water flow rate in l/hr, determined in accordance with a method which has been submitted to and approved by the Administrator.
10^{-6} = Conversion factor for ppm.
Z = Production rate (kg/hr), determined in accordance with a method which has been submitted and approved by the Administrator.

(5) The reactor opening loss for which an emission limit is prescribed in § 61.64(a)(2) is to be determined. The number of reactors for which the determination is to be made is to be specified by the Administrator for each individual plant at the time of the determination based on the plant's operation. For a reactor that is also used as a stripper, the determination may be made immediately following the stripping operation.

(i) Except as provided in paragraph (g)(5)(ii) of this section, the reactor opening loss is to be determined using the following equation:

$$C = \frac{W\ (2.60)\ (10^{-6})\ (Cb)}{YZ}$$

where:

C = kg vinyl chloride emissions/kg product.
W = Capacity of the reactor in m^3.
2.60 = Density of vinyl chloride at one atmosphere and 20° C in kg/m^3.
10^{-6} = Conversion factor for ppm.
Cb = ppm by volume vinyl chloride as determined by Test Method 106 or a portable hydrocarbon detector which measures hydrocarbons with a sensitivity of at least 10 ppm.
Y = Number of batches since the reactor was last opened to the atmosphere.
Z = Average kg of polyvinyl chloride produced per batch in the number of batches since the reactor was last opened to the atmosphere.

(A) If Method 106 is used to determine the concentration of vinyl chloride (Cb), the sample is to be withdrawn at a constant rate with a probe of sufficient length to reach the vessel bottom from the manhole. Samples are to be taken for 5 minutes within 6 inches of the vessel bottom, 5 minutes near the vessel center, and 5 minutes near the vessel top.

(B) If a portable hydrocarbon detector is used to determine the concentration of vinyl chloride (Cb), a probe of sufficient length to reach the vessel bottom from the manhole is to be used to make the measurements. One measurement will be made within 6 inches of the vessel bottom, one near the vessel center and one near the vessel top. Measurements are to be made at each location until the reading is stabilized. All hydrocarbons measured are to be assumed to be vinyl chloride.

(C) The production rate of polyvinyl chloride (Z) is to be determined by a method submitted to and approved by the Administrator.

(ii) A calculation based on the number of evacuations, the vacuum involved, and the volume of gas in the reactor is hereby approved by the Administrator as an alternative method for determining reactor opening loss for postpolymerization reactors in the manufacture of bulk resins.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c–9).)

§ 61.68 Emisison monitoring.

(a) A vinyle chloride monitoring system is to be used to monitor on a continuous basis the emissions from the sources for which emission limits are prescribed in § 61.62(a) and (b), § 61.63(a), and § 61.64(a)(1), (b), (c), and (d), and for any control system to which reactor emissions are required to be ducted in §61.64(a)(2) or to which fugitive emissions are required to be ducted in § 61.65(b)(1)(ii), and (b)(2), (b)(5), (b)(6)(ii), and (b)(9)(ii).

(b) The vinyl chloride monitoring system(s) used to meet the requirement in paragraph (a) of this section is to be a device which obtains air sampels from one or more points on a continuous sequential basis and analyzes the samples with gas chromotography or, if the owner or operator assumes that all hydrocarbons measured are vinyl chloride, with infrared spectrophotometry, flame ion detection, or an equivalent or alternative method. The vinyl chloride monitoring system used to meet the requirements in § 61.65(b)(8)(i) may be used to meet the requirements of this section.

(c) A daily span check is to be conducted for each vinyle chloride monitoring system used. For all of the emission sources listed in paragraph (a) of this section, except the one for which an emission limit is prescribed in § 61.62(b), the daily span check is to be conducted with a concentration of vinyl chloride equal to 10 ppm. For the emission source for which an emission limit is prescribed in § 61.62(b), the daily span check is to be conducted with a concentration of vinyl chloride which is determined to be equivalent to the emission limit for that source based on the emission test required by § 67.67. The calibration is to be done with either:

(1) A calibration gas mixture prepared from the gases specified in sections 5.2.1 and 5.2.2 of Test Method 106 and in accordance with section 7.1 of Test Method 106, or

(2) A calibration gas cylinder standard containing the appropriate concentration of vinyl chloride. The gas composition of the calibration gas cylinder standard is to have been certified by the manufacturer. The manufacturer must have recommended a maximum shelf life for each cylinder so that the concentration does not change greater than ±5 percent from the certified value. The date of gas cylinder preparation, certified vinyl chloride concentration and recommended maximum shelf life must have been affixed to the cylinder before shipment from the manufacturer to the buyer. If a gas chromatograph is used as the vinyl chloride monitoring system, these gas mixtures may be directly used to prepare a chromatograph calibration curve as described in section 7.3 of Test Method 106. The requirements in sections 5.2.3.1 and 5.2.3.2 of Test Method 106 for certification of cylinder standards and for establishment and verification of calibration standards are to be followed.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c–9).)

§ 61.69 Initial report.

(a) An owner or operator of any source to which this subpart applies shall submit a statement in writing notifying the Administrator that the equipment and procedural specifications in §§ 61.65 (b)(1), (b)(2), (b)(3), (b)(4), (b)(5), (b)(6), (b)(7), and (b)(8) are being implemented.

(b)(1) In the case of an existing source or a new source which has an initial startup date preceding the effective date, the statement is to be submitted within 90 days of the effective date, unless a waiver of compliance is granted under § 61.11, along with the information required under § 61.10. If a waiver of compliance is granted, the statement is to be submitted on a date scheduled by the Administrator.

(2) In the case of a new source which did not have an initial startup date preceding the effective date, the statement is to be submitted within 90 days of the initial startup date.

(c) The statement is to contain the following information:

(1) A list of the equipment installed for compliance,

(2) A description of the physical and functional characteristics of each piece of equipment.

(3) A description of the methods which have been incorporated into the standard operating procedures for measuring or calculating the emissions for which emission limits are prescribed in §§ 61.65 (b)(1)(i) and (b)(6)(i),

(4) A statement that each piece of equipment is installed and that each piece of equipment and each procedure is being used.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c–9).)

§ 61.70 Semiannual report.

(a) The owner or operator of any
(a)(2) is to be determined. The number
source to which this subpart applies shall submit to the Administrator on September 15 and March 15 of each year a report in writing containing the information required by this section. The first semiannual report is to be submitted following the first full 6 month reporting period after the initial report is submitted.

(b)(1) In the case of an existing source or a new source which has an initial startup date preceding the effective date, the first report is to be submitted within 180 days of the effective date, unless a waiver of compliance is granted under § 61.11. If a waiver of compliance is granted, the first report is to be submitted on a date scheduled by the Administrator.

(2) In the case of a new source which did not have an initial startup date preceding the effective date, the first report is to be submitted within 180 days of the initial startup date.

(c) Unless otherwise specified, the owner or operator shall use the Test Methods in Appendix B to this part to conduct emission tests as required by paragraphs (c)(2) and (c)(3) of this section, unless an equivalent or an alternative method has been approved by the Administrator. If the Administrator finds reasonable grounds to dispute the results obtained by an equivalent or alternative method, he may require the use of a reference method. If the results of the reference and equivalent or alternative methods do not agree, the results obtained by the reference method prevail, and the Administrator may notify the owner or operator that approval of the method previously considered to be equivalent or alternative is withdrawn.

(1) The owner or operator shall include in the report a record of any emissions which averaged over any hour period (commencing on the hour) are in excess of the emission limits prescribed in §§ 61.62(a) or (b), § 61.63(a), or §§ 61.64(a)(1), (b), (c), or (d), or for any control system to which reactor emissions are required to be ducted in § 61.64(a)(2) or to which fugitive emissions are required to be ducted in § 61.65 (b)(1)(ii), (b)(2), (b)(5), (b)(6)(ii), or (b)(9)(ii). The emissions are to be measured in accordance with § 61.68.

(2) In polyvinyl chloride plants for which a stripping operation is used to attain the emisison level prescribed in § 61.64(e), the owner or operator shall include in the report a record of the vinyl chloride content in the polyvinyl chloride resin. Test Method 107 is to be used to determine vinyl chloride content as follows:

(i) If batch stripping is used, one representative sample of polyvinyl chloride resin is to be taken from each batch of each grade of resin immediately following the completion of the stripping operation, and identified by resin type and grade and the date and time the batch is completed. The corresponding quantity of material processed in each stripper batch is to be recorded and identified by resin type and grade and the date and time the batch is completed.

(ii) If continuous stripping is used, one representative sample of polyvinyl chloride resin is to be taken for each grade of resin processed or at intervals of 8 hours for each grade of resin which is being processed, whichever is more frequent. The sample is to be taken as the resin flows out of the stripper and identified by resin type and grade and the date and time the sample was taken. The corresponding quantity of material processed by each stripper over the time period represented by the sample during the eight hour period, is to be recorded and identified by resin type and grade and the date and time it represents.

(iii) The quantity of material processed by the stripper is to be determined on a dry solids basis and by a method submitted to and approved by the Administrator.

(iv) At the prior request of the Administrator, the owner or operator shall provide duplicates of the samples required in paragraphs (c)(2)(i) and (c)(2)(ii) of this section.

(v) The report to the Administrator by the owner or operator is to include the vinyl chloride content found in each sample required by paragraphs (c)(2)(i) and (c)(2)(ii) of this section, averaged separately for each type of resin, over each calendar day and weighted according to the quantity of each grade of resin processed by the stripper(s) that calendar day, according to the following equation:

$$A_{T_i}=\frac{\sum_{i}^{n}=1\,P_{G_i}M_{G_i}}{Q_{T_i}}=\frac{P_{G_1}M_{G_1}+P_{G_2}M_{G_2}+\cdots+P_{G_n}M_{G_n}}{Q_{T_i}}$$

where:

A = 24-hour average concentration of type T_i resin in ppm (dry weight basis).

Q = Total production of type T_i resin over the 24-hour period, in kg.

T_i = Type of resin; $i=1,2 \ldots m$ where m is total number of resin types produced during the 24-hour period.

M = Concentration of vinyl chloride in one sample of grade G_i resin, in ppm.

P = Production of grade G_i resin represented by the sample, in kg.

G_i = Grade of resin; e.g., G_1, G_2, and G_3.

n = Total number of grades of resin produced during the 24-hour period.

(vi) The owner or operator shall retain at the source and make available for inspection by the Administrator for a minimum of 2 years records of all data needed to furnish the information required by paragraph (c)(2)(v) of this section. The records are to contain the following information:

(A) The vinyl chloride content found in all the samples required in paragraphs (c)(2)(i) and (c)(2)(ii) of this section, identified by the resin type and grade and the time and date of the sample, and

(B) The corresponding quantity of polyvinyl chloride resin processed by the stripper(s), identified by the resin type and grade and the time and date it represents.

(3) The owner or operator shall include in the report a record of the emissions from each reactor opening for which an emission limit is prescribed in § 61.64(a)(2). Emissions are to be determined in accordance with § 61.67(g)(5), except that emissions for each reactor are to be determined. For a reactor that is also used as a stripper, the determination may be made immediately following the stripping operation.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c–9).)

§ 61.71 Recordkeeping.

(a) The owner or operator of any source to which this subpart applies shall retain the following information at the source and make it available for inspection by the Administrator for a minimum of two years;

(1) A record of the leaks detected by the vinyl chloride monitoring system, as required by § 61.65(b)(8), including the concentrations of vinyl chloride as measured, analyzed, and recorded by the vinyl chloride detector, the location of each measurement and the date and approximate time of each measurement.

(2) A record of the leaks detected during routine monitoring with the portable hydrocarbon detector and the action taken to repair the leaks, as required by § 61.65(b)(8), including a brief statement explaining the location and cause of each leak detected with the portable hydrocarbon detector, the date and time of the leak, and any action taken to eliminate that leak.

(3) A record of emissions measured in accordance with § 61.68.

(4) A daily operating record for each polyvinyl chloride reactor, including pressures and temperatures.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c–9).)

* * * * *

METHOD 106—DETERMINATION OF VINYL CHLORIDE FROM STATIONARY SOURCES

INTRODUCTION

Performance of this method should not be attempted by persons unfamiliar with the operation of a gas chromatograph, nor by those who are unfamiliar with source sampling, as there are many details that are beyond the scope of this presentation. Care must be exercised to prevent exposure of sampling personnel to vinyl chloride, a carcinogen.

1. Principle and Applicability.

1.1 An integrated bag sample of stack gas containing vinyl chloride (chloroethene) is subjected to chromatographic analysis, using a flame ionization detector.

1.2 The method is applicable to the measurement of vinyl chloride in stack gases from ethylene dichloride, vinyl chloride and polyvinyl chloride manufacturing processes, except where the vinyl chloride is contained in particulate matter.

2. Range and Sensitivity.

The lower limit of detection will vary according to the chromatograph used. Values reported include 1 × 10^{-7} mg and 4 × 10^{-7} mg.

3. *Interferences*. Acetaldehyde, which can occur in some vinyl chloride sources, will interfere with the vinyl chloride peak from the Chromasorb 102[1] column. See sections 4.3.2 and 6.4. If resolution of the vinyl chloride peak is still not satisfactory for a particular sample, then chromatograph parameters can be further altered with prior approval of the Administrator. If alteration of the chromatograph parameters fails to resolve the vinyl chloride peak, then supplemental confirmation of the vinyl chloride peak through an absolute analytical technique, such as mass spectroscopy, must be performed.

4. Apparatus.

4.1 Sampling (Figure 106-1).

4.1.1 Probe—Stainless steel, Pyrex glass, or Teflon tubing according to stack temperature, each equipped with a glass wool plug to remove particulate matter.

4.1.2 Sample line—Teflon, 6.4 mm outside diameter, of sufficient length to connect probe to bag. A new unused piece is employed for each series of bag samples that constitutes an emission test.

4.1.3 Male (2) and female (2) stainless steel quick-connects, with ball checks (one pair without) located as shown in Figure 106-1.

4.1.4 Tedlar bags, 100 liter capacity—To contain sample. Teflon bags are not acceptable. Aluminized Mylar bags may be used, provided that the samples are analyzed within 24 hours of collection.

4.1.5 Rigid leakproof containers for 4.1.4, with covering to protect contents from sunlight.

4.1.6 Needle valve—To adjust sample flow rate.

4.1.7 Pump—Leak-free. Minimum capacity 2 liters per minute.

4.1.8 Charcoal tube—To prevent admission of vinyl chloride to atmosphere in vicinity of samplers.

4.1.9 Flow meter—For observing sample flow rate; capable of measuring a flow range from 0.10 to 1.00 liter per minute.

4.1.10 Connecting tubing— Teflon, 6.4 mm outside diameter, to assemble sample train (Figure 106-1).

4.1.11 Pitot tube—Type S (or equivalent), attached to the probe so that the sampling flow rate can be regulated proportional to the stack gas velocity.

4.2 Sample recovery.

4.2.1 Tubing—Teflon, 6.4 mm outside diameter, to connect bag to gas chromatograph sample loop. A new unused piece is employed for each series of bag samples that constitutes an emission test, and is to be discarded upon conclusion of analysis of those bags.

4.3 Analysis.

4.3.1 Gas chromatograph—With flame ionization detector, potentiometric strip chart recorder and 1.0 to 5.0 ml heated sampling loop in automatic sample valve.

4.3.2 *Chromatographic column*. Stainless steel, 2 m×3.2 mm, containing 80/100 mesh Chromasorb 102. A secondary column of GE SF-96, 20 percent on 60/80 mesh AW Chromasorb P, stainless steel, 2 m×3.2 mm or Porapak T, 80/100 mesh, stainless steel, 1 m×3.2 mm is required if acetaldehyde is present. If used, a secondary column is placed after the Chromasorb 102 column. The combined columns should then be operated at 120° C.

4.3.3 Flow meters (2)—Rotameter type, 0 to 100 ml/min capacity, with flow control valves.

4.3.4 Gas regulators—For required gas cylinders.

4.3.5 Thermometer—Accurate to one degree centigrade, to measure temperature of heated sample loop at time of sample injection.

4.3.6 Barometer—Accurate to 5 mm Hg, to measure atmospheric pressure around gas chromatograph during sample analysis.

4.3.7 Pump—Leak-free. Minimum capacity 100 ml/min.

4.4 Calibration.

4.4.1 Tubing—Teflon, 6.4 mm outside diameter, separate pieces marked for each calibration concentration.

4.4.2 Tedlar bags—Sixteen-inch square size, separate bag marked for each calibration concentration.

4.4.3 Syringe—0.5 ml, gas tight.

4.4.4 Syringe—50μl, gas tight.

4.4.5 Flow meter—Rotameter type, 0 to 1000 ml/min range accurate to ±1%, to meter nitrogen in preparation of standard gas mixtures.

4.4.6 Stop watch—Of known accuracy, to time gas flow in preparation of standard gas mixtures.

5. Reagents. It is necessary that all reagents be of chromatographic grade.

5.1 Analysis.

5.1.1 Helium gas or nitrogen gas—Zero grade, for chromatographic carrier gas.

5.1.2 Hydrogen gas—Zero grade.

5.1.3 Oxygen gas, or Air, as required by the detector—Zero grade.

5.2 Calibration. Use one of the following options: either 5.2.1 and 5.2.2, or 5.2.3.

5.2.1 *Vinyl chloride, 99.9+ percent*. Pure vinyl chloride gas certified by the manufacturer to contain a minimum of 99.9 percent vinyl chloride for use in the preparation of standard gas mixtures in Section 7.1. If the gas manufacturer maintains a bulk cylinder supply of 99.9+ percent vinyl chloride, the certification analysis may have been performed on this supply rather than on each gas cylinder prepared from this bulk supply. The date of gas cylinder preparation and the certified analysis must have been affixed to the cylinder before shipment from the gas manufacturer to the buyer.

5.2.2 *Nitrogen gas*. Zero grade, for preparation of standard gas mixtures.

5.2.3 *Cylinder standards* (3). Gas mixture standards (50, 10, and 5 ppm vinyl chloride in nitrogen cylinders) for which the gas composition has been certified by the manufacturer. The manufacturer must have recommended a maximum shelf life for each cylinder so that the concentration does not change greater than ±5 percent from the certified value. The date of gas cylinder preparation, certified vinyl chloride concentration and recommended maximum shelf life must have been affixed to the cylinder before shipment from the gas manufacturer to the buyer. These gas mixture standards may be directly used to prepare a chromatograph calibration curve as described in section 7.3.

5.2.3.1 *Cylinder standards certification*. The concentration of vinyl chloride in nitrogen in each cylinder must have been certified by the manufacturer by a direct analysis of each cylinder using an analytical procedure that the manufacturer had calibrated on the day of cylinder analysis. The calibration of the analytical procedure shall, as a minimum, have utilized a three-point calibration curve. It is recommended that the manufacturer maintain two calibration standards and use these standards in the following way: (1) a high concentration standard (between 50 and 100 ppm) for preparation of a calibration curve by an appropriate dilution technique; (2) a low concentration standard (between 5 and 10 ppm) for verification of the dilution technique used.

5.2.3.2 *Establishment and verification of calibration standards*. The concentration of each calibration standard must have been established by the manufacturer using reliable procedures. Additionally, each calibration standard must have been verified by the manufacturer by one of the following procedures, and the agreement between the initially determined concentration value and the verification concentration value must be within ± 5 percent: (1) verification value determined by comparison with a calibrated vinyl chloride permeation tube, (2) verification value determined by comparison with a gas mixture prepared in accordance with the procedure described in section 7.1 and using 99.9+ percent vinyle chloride, or (3) verification value obtained by having the calibration standard analyzed by the National Bureau of Standards. All calibration standards must be renewed on a time interval consistent with the shelf life of the cylinder standards sold.

6. Procedure.

6.1 Sampling. Assemble the sample train as in Figure 106-1. Perform a bag leak check according to Section 7.4. Observe that all connections between the bag and the probe are tight. Place the end of the probe at the centroid of the stack and start the pump with the needle valve adjusted to yield a flow of 0.5 lpm. After a period of time sufficient to purge the line several times has elapsed, connect the vacuum line to the bag and evacuate the bag until the rotameter indicates no flow. Then reposition the sample and vacuum lines and begin the actual sampling, keeping the rate proportional to the stack velocity. Direct the gas exiting the rotameter away from sampling personnel. At the end of the sample period, shut off the pump, disconnect the sample line from the bag, and disconnect the vacuum line from the bag container. Protect the bag container from sunlight.

6.2 Sample storage. Sample bags must be kept out of direct sunlight. When at all possible analysis is to be performed within 24 hours, but in no case in excess of 72 hours of sample collection.

6.3 Sample recovery. With a piece of Teflon tubing identified for that bag, connect a bag inlet valve to the gas chromatograph sample valve. Switch the valve to withdraw gas from the bag through the sample loop. Plumb the equipment so the sample gas passes from the sample valve to the leak-free pump, and then to a charcoal tube, followed by a 0-100 ml/min rotameter with flow control valve.

6.4 Analysis. Set the column temperature

---

[1] Mention of trade names on specific products does not constitute endorsement by the Environmental Protection Agency.

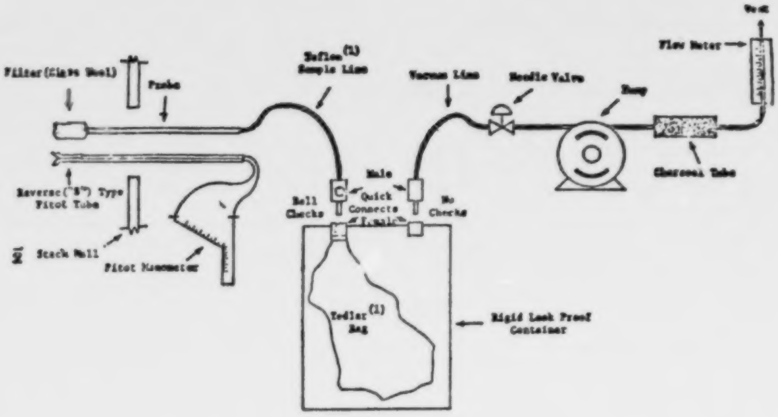


Figure 106-1. Integrated bag sampling train.

(1) Mention of trade names on specific products does not constitute endorsement by the Environmental Protection Agency.

to 100° C the detector temperature to 150° C, and the sample loop temperature to 70° C. When optimum hydrogen and oxygen flow rates have been determined verify and maintain these flow rates during all chromatograph operations. Using zero helium or nitrogen as the carrier gas, establish a flow rate in the range consistent with the manufacturer's requirements for satisfactory detector operation. A flow rate of approximately 40 ml/min should produce adequate separations. Observe the base line periodically and determine that the noise level has stabilized and that base line drift has ceased. Purge the sample loop for thirty seconds at the rate of 100 ml/min, then activate the sample valve. Record the injection time (the position of the pen on the chart at the time of sample injection), the sample number, the sample loop temperature, the column temperature, carrier gas flow rate, chart speed and the attenuator setting. Record the laboratory pressure. From the chart, select the peak having the retention time corresponding to vinyl chloride, as determined in Section 7.2. Measure the peak area, A_m, by use of a disc integrator or a planimeter. Measure the peak height, H_m. Record A_m H_m, and the retention time. Repeat the injection at least two times or until two consecutive vinyl chloride peaks do not vary in area more than 5%. The average value for these two areas will be used to compute the bag concentration.

Compare the ratio of H_m to A_m for the vinyl chloride sample with the same ratio for the standard peak which is closest in height. As a guideline, if these ratios differ by more than 10%, the vinyl chloride peak may not be pure (possibly acetaldehyde is present) and the secondary column should be employed (see Section 4.3.2).

6.5 Measure the ambient temperature and barometric pressure near the bag. (Assume the relative humidity to be 100 percent.) From a water saturation vapor pressure table, determine and record the water vapor content of the bag.

7. Calibration and Standards.

7.1 *Preparation of vinyl chloride standard gas mixtures.* Evacuate a sixteen-inch square Tedlar bag that has passed a leak check (described in Section 7.4) and meter in 5 liters of nitrogen. While the bag is filling, use the 0.5 ml syringe to inject 250μl of 99.9+ percent vinyl chloride through the wall of the bag. Upon withdrawing the syringe needle, immediately cover the resulting hole with a piece of adhesive tape. The bag now contains a vinyl chloride concentration of 50 ppm. In a like manner use the other syringe to prepare gas mixtures having 10 and 5 ppm vinyl chloride concentrations. Place each bag on a smooth surface and alternately depress opposite sides of the bag 50 times to further mix the gases. These gas mixture standards may be used for 10 days from the date of preparation, after which time preparation of new gas mixtures is required. (CAUTION.—Contamination may be a problem when a bag is reused if the new gas mixture standard contains a lower concentration than the previous gas mixture standard did.)

7.2 Determination of vinyl chloride retention time. This section can be performed simultaneously with Section 7.3. Establish chromatograph conditions identical with those in Section 6.3, above. Set attenuator to X 1 position. Flush the sampling loop with zero helium or nitrogen and activate the sample valve. Record the injection time, the sample loop temperature, the column temperature, the carrier gas flow rate, the chart speed and the attenuator setting. Record peaks and detector responses that occur in the absence of vinyl chloride. Maintain conditions. With the equipment plumbing arranged identically to Section 6.2, flush the sample loop for 30 seconds at the rate of 100 ml/min with one of the vinyl chloride calibration mixtures and activate the sample valve. Record the injection time. Select the peak that corresponds to vinyl chloride. Measure the distance on the chart from the injection time to the time at which the peak maximum occurs. This quantity, divided by the chart speed, is defined as the retention time. Record.

7.3 Preparation of chromatograph calibration curve. Make a gas chromatographic measurement of each gas mixture standard (described in section 5.2.2 or 7.1) using conditions identical with those listed in sections 6.3 and 6.4. Flush the sampling loop for 30 seconds at the rate of 100 ml/min with each standard gas mixture and activate the sample valve. Record C_c, the concentration of vinyl chloride injected, the attenuator setting, chart speed, peak area, sample loop temperature, column temperature, carrier gas flow rate, and retention time. Record the laboratory pressure. Calculate A_c, the peak area multiplied by the attenuator setting. Repeat until two injection areas are within 5 percent, then plot these points v. C_c. When the other concentrations have been plotted, draw a smooth curve through the points. Perform calibration daily, or before and after each set of bag samples, whichever is more frequent.

7.4 Bag leak checks. While performance of this section is required subsequent to bag use, it is also advised that it be performed prior to bag use. After each use, make sure a bag did not develop leaks as follows. To leak check, connect a water manometer and pressurize the bag to 5–10 cm H_2O (2–4 in H_2O). Allow to stand for 10 minutes. Any displacement in the water manometer indicates a leak. Also check the rigid container for leaks in this manner.

(NOTE: An alternative leak check method is to pressurize the bag to 5–10 cm H_2O or 2–4 in. H_2O and allow to stand overnight. A deflated bag indicates a leak.) For each sample bag in its rigid container, place a rotameter in-line between the bag and the pump inlet. Evacuate the bag. Failure of the rotameter to register zero flow when the bag appears to be empty indicates a leak.

8. Calculations.

8.1 Determine the sample peak area as follows:

$$A_s = A_m A_f$$

Equation 106-1

where:

A_s=The sample peak area.
A_m=The measured peak area.
A_f=The attenuation factor.

8.2 Vinyl chloride concentrations. From the calibration curve described in Section 7.3, above, select the value of C_c that corresponds to A_c, the sample peak area. Calculate C_b as follows:

$$C_b = \frac{C_c P_r T_i}{P_i T_r (1 - B_{wb})}$$

Equation 106-2

Where:

B_{wb}=The water vapor content of the bag samble, as analyzed.
C_b=The concentration of vinyl chloride in the bag sample in ppm.
C_c=The concentration of vinyl chloride indicated by the gas chromatograph, in ppm.
P_r=The reference pressure, the laboratory pressure recorded during calibration, mm Hg.
T_i=The sample loop temperature on the absolute scale at the time of analysis, °K.
P_i=The laboratory pressure at time of analysis, mm Hg.
T_r=The reference temperature, the sample loop temperature recorded during calibration, °K.

9. References.

1. Brown, D. W., Loy, E. W. and Stephenson, M. H. "Vinyl Chloride Monitoring Near the B. F. Goodrich Chemical Company in Louisville, Kentucky." Region IV, U.S. Environmental Protection Agency, Surveillance and Analysis Division, Athens, Georgia, June 24, 1974.

2. "Evaluation of A Collection and Analytical Procedure for Vinyl Chloride in Air," by G. D. Clayton and Associates, December 13, 1974. EPA Contract No. 68-02-1408, Task Order No. 2, EPA Report oN. 75-VCL-1.

3. "Standardization of Stationary Source Emission Method for Vinyl Chloride," by Midwest Research Institute, 1976. EPA Contract No. 68-02-1098, Task Order No. 7.

Reproduced from best available copy.

Title 40—Protection of Environment

CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY

SUBCHAPTER C—AIR PROGRAMS

[FRL 618-1]

PART 61—NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS

Standard for Vinyl Chloride

On December 24, 1975, under section 112 of the Clean Air Act, as amended (42 U.S.C. 1857), the Environmental Protection Agency (EPA) added vinyl chloride to the list of hazardous air pollutants (40 FR 59477) and proposed a national emission standard for it (40 FR 59532). The standard covers plants which manufacture ethylene dichloride, vinyl chloride, and/or polyvinyl chloride.

EPA decided to regulate vinyl chloride because it has been implicated as the causal agent of angiosarcoma and other serious disorders, both carcinogenic and noncarcinogenic, in people with occupational exposure and in animals with experimental exposure to vinyl chloride. Reasonable extrapolations from these findings cause concern that vinyl chloride may cause or contribute to the same or similar disorders at present ambient air levels. The purpose of the standard is to minimize vinyl chloride emissions from all known process and fugitive emission sources in ethylene dichloride-vinyl chloride and polyvinyl chloride plants to the level attainable with best available control technology. This will have the effect of furthering the protection of public health by minimizing the health risks to the people living in the vicinity of these plants and to any additional people who are exposed as a result of new construction.

Interested parties participated in the rulemaking by sending comments to EPA. The comments have been carefully considered, and where determined by the Administrator to be appropriate, changes have been made to the regulation as promulgated.

SUMMARY OF THE STANDARD

In ethylene dichloride-vinyl chloride plants, the standard limits vinyl chloride emissions from the ethylene dichloride and vinyl chloride formation and purification processes to 10 ppm. For the oxychlorination process, vinyl chloride emissions are limited to 0.2 g/kg of ethylene dichloride product.

In polyvinyl chloride plants, the standard limits vinyl chloride emissions from equipment preceding and including the stripper in the plant process flow to 10 ppm. Emissions from equipment following the stripper are to be controlled by stripping dispersion resins to 2000 ppm and other resins to 400 ppm, or by using equivalent controls. Vinyl chloride emissions from reactor opening are to be reduced to 0.02 g/kg polyvinyl chloride product.

In both ethylene dichloride-vinyl chloride and polyvinyl chloride plants, relief valve discharges and manual venting of gases are prohibited except under emergency conditions. Fugitive emissions are required to be captured and controlled.

HEALTH AND ENVIRONMENTAL IMPACTS

EPA prepared a document entitled the *Quantitative Risk Assessment for Community Exposure to Vinyl Chloride* which estimates the risk from vinyl chloride exposure to populations living in the vicinity of vinyl chloride-emitting plants before and after implementation of controls to meet the standard. There are no dose-response data for the concentrations of vinyl chloride found in the ambient air. Therefore, assessments of risk at ambient levels of exposure were extrapolated from dose-response data from higher levels of exposure using both a linear model and a log-probit model. Extrapolations made with each of these models entailed using different sets of assumptions. Because different assumptions can be made in extrapolating to low doses, the health risks are reported in ranges.

It was estimated that 4.6 million people live within 5 miles of ethylene dichoride-vinyl chloride and polyvinyl chloride plants and that the average exposure around these plants before installation of controls to meet the standard is 17 parts per billion. The exposure levels for uncontrolled plants were calculated based on estimated 1974 emission levels. Using the linear dose-response model, EPA found that the rate of initiation of liver angiosarcoma among people living around uncontrolled plants is expected to range from less than one to ten cases of liver angiosarcoma per year of exposure to vinyl chloride. The log-probit model gave predictions that are 0.1 to 0.01 times this rate. This wide range is an indication of the uncertainties in extrapolation to low doses. Due to the long latency time observed in cancer cases resulting from vinyl chloride exposure, increases initiated by exposure this year will not be diagnosed until the 1990's or later. Vinyl chloride is also estimated to produce an equal number of primary cancers at other sites, for a total of somewhere between less than one and twenty cases of cancer per year of exposure among residents around plants. The number of these effects is expected to be reduced at least in proportion to the reduction in the ambient annual average vinyl chloride concentration, which is expected to be 5 percent of the uncontrolled levels after the standard is implemented.

Changes in the standard since proposal do not affect the level of control required. Thus, the environmental impact of the promulgated standard is, with one exception, the same as that described in Chapter 6 of Volume I of the *Standard Support and Environmental Impact Statement*. According to data submitted by the Society of Plastics Industry, Inc. (SPI), the impact on water consumption in the draft environmental impact statement was overstated. In estimating the impact on water consumption, EPA based its estimates on worst case conditions. That is, EPA assumed that those control systems with the greatest water usage would be employed and that there would be no recycling of water. There is no regulation which would require water recycling. According to SPI, the control system utilizing the most water will not be used generally by the industry and economic factors will cause plants to recycle much of the water. Therefore, according to SPI the impact of the standard on water consumption will be negligible.

The environmental impacts of the promulgated standard may be summarized as follows: The primary environmental impacts of the standard are beneficial and will consist of vinyl chloride emission reductions of approximately 94 percent at ethylene dichloride-vinyl chloride plants and 95 percent at polyvinyl chloride plants. Percentage numbers for both source categories are based on an estimated 90 percent reduction in fugitive emissions and 1974 emission levels.

The potential secondary environmental impacts of the standard are either insignificant or will be minimized without additional action, except for one adverse impact. Hydrogen chloride is already emitted by process equipment at ethylene dichloride-vinyl chloride plants and by other petrochemical plants in the complexes where ethylene dichloride-vinyl chloride plants are typically located. An incinerator used to attain the standard at an ethylene dichloride-vinyl chloride plant could increase hydrogen chloride emissions by several fold. Typically, however, due to the corrosion problems which would otherwise occur both on plant property and in the community, plants use scrubbers to control already existing hydrogen chloride emissions. Hydrogen chloride emissions resulting from control of vinyl chloride emissions are expected to be controlled for the same reason. If even a moderately efficient scrubber (98 percent control) were used to control the hydrogen chloride emissions resulting from incineration of vinyl chloride emissions, the increase in hydrogen chloride emissions from a typical ethylene dichloride-vinyl chloride plant due to the standard would be reduced to 35 percent. However, EPA plans to further evaluate the need to control hydrogen chloride emissions, since diffusion model results indicate that under "worst-case" meteorological conditions, the hydrogen chloride emissions from the process equipment and the incinerator combined would cause maximum ambient concentrations of hydrogen chloride in the vicinity of ethylene dichloride-vinyl chloride plants to be in the same range or somewhat higher than existing foreign standards and National Academy of Sciences (NAS) guidelines for public exposure.

ECONOMIC IMPACT

In accordance with Executive Order 11821 and OMB circular A-107, EPA carefully evaluated the economic and inflationary impact of the proposed standard and alternative control levels and certified this in the preamble to the proposed standard. These impacts are discussed in Chapter 7 of Volume I of the *Standard Support and Environmental Impact Statement*. Comments on the proposed standard have resulted in only one major change in the economic impact analysis. EPA estimated that there would be four plant closures as a result of the promulgated standard. Of the four plants identified as possible closure candidates, one has given notice that it no longer produces polyvinyl chloride and the other three have indicated that they do not intend to close as a result of the standard.

The economic impacts of the promulgated standard may be summarized as follows: The total capital cost for existing plants to meet the standard is estimated to be $198 million, of which $15 million is for ethylene dichloride-vinyl chloride plants and $183 million is for polyvinyl chloride plants. EPA estimates that these plants will have to spend $70 million per year to maintain the required emission levels. In addition, the total capital cost for existing plants to meet the EPA's 1983 water effluent guideline limitations is expected to be $83 million and the total annualized operation cost is $17 million. The costs to the industry of meeting the OSHA standard cannot be quantified at this time, but they are expected to overlap to some degree with the costs to meet EPA's fugitive emission regulations. The costs of meeting the fugitive emission regulations are included in the total costs cited above for meeting the promulgated regulation. Broken out separately, the capital cost of meeting the fugitive emission regulations is $37 million and the annualized cost is $25 million.

The standard is not expected to deter construction of new ethylene dichloride-vinyl chloride plants or most types of new polyvinyl chloride plants. For one type of polyvinyl chloride plant (dispersion process) that represents 13 percent of the industry production, the standard would significantly deter the construction of smaller plants.

It is estimated that the price of polyvinyl chloride resins will rise by approximately 7.3 percent in order to maintain precontrol profitability and also to recover the total annualized control costs necessitated by the standard at ethylene dichloride-vinyl chloride plants and polyvinyl chloride plants. This increase is estimated to translate into a maximum consumer price increase in goods fabricated from polyvinyl chloride resins of approximately 3.5 percent. Recovery of effluent annualized costs plus maintenance of precontrol profitability is estimated to add approximately 2 percent to polyvinyl chloride resin prices and result in an additional maximum consumer price increase of 1 percent.

PUBLIC PARTICIPATION

During the public comment period, 50 comment letters on the proposed standard were received. There were 24 from industry; 3 from environmental groups; 15 from Federal, State, and local agencies; and 8 from individual citizens. As required by section 112(b)(1)(B) of the Act, a public hearing was held on the proposed standard on February 3, 1976, in Washington, D.C. Presentations were made by the Environmental Defense Fund, the Society of the Plastics Industry, Inc., Dow Chemical Company, Diamond Shamrock Corporation, and Air Products and Chemicals, Inc. Copies of the comment letters received, the public hearing record, and a summary of the comments with EPA's responses are available for public inspection and copying at the EPA Public Information Reference Unit, Room 2922 (EPA Library), 401 M Street, SW., Washington, D.C. In addition, copies of the comment summary and Agency responses may be obtained upon written request from the Public Information Center (PM-215), Environmental Protection Agency, 401 M Street, SW., Washington, D.C. 20460 (specify *Standard Support and Environmental Impact Statement, Emission Standard for Vinyl Chloride, Volume II*).

SIGNIFICANT COMMENTS AND CHANGES TO THE PROPOSED REGULATION

(1) *Decision to list vinyl chloride as a hazardous air pollutant.* In general, the commenters did not contest EPA's decision to list vinyl chloride as a hazardous air pollutant. However, three commenters (two companies and one Federal agency) argued that EPA placed undue emphasis on factors suggesting that vinyl chloride presented a health risk and ignored factors suggesting that no significant risk was involved. Under section 112, however, EPA could remove vinyl chloride from the list of hazardous air pollutants only if information were presented to EPA that shows that vinyl chloride is clearly not a hazardous air pollutant. As discussed more fully in the comment summary, the commenters did not provide conclusive evidence that vinyl chloride is not a hazardous air pollutant which causes or contributes to death or serious illness, nor did they conclusively prove that the health risk factors emphasized by EPA were insignificant.

Several other commenters agreed with EPA's decision to list vinyl chloride as a hazardous air pollutant, but argued that EPA had overstated the health problem, the emission levels, and the projected ambient air concentrations around uncontrolled plants. With regard to the alleged overstated health problem, the commenters stated, for example, that the U.S. worker EPA discussed as having been exposed to vinyl chloride levels lower than those usually encountered in polyvinyl chloride production has been dropped from the National Institute of Occupational Safety and Health's listing of workers with angiosarcoma. EPA agrees that there are questions concerning the level of exposure and in some cases the pathology of these cases not involved directly in polyvinyl chloride and vinyl chloride production. These uncertainties are stated in the appropriate footnotes of the *Scientific and Technical Assessment Report on Vinyl Chloride and Polyvinyl Chloride* (STAR) where the angiosarcoma cases are listed. However, in spite of these uncertainties, in view of the possible exposure patterns, these cases cannot be ignored in the evaluation of the potential public health problems.

With regard to the alleged overstated emission levels, the uncontrolled emission levels reported by EPA were based on 1974 data. This qualification was stated wherever emission data were presented. EPA recognizes that emissions have been reduced since that time, and stated this in the preamble to the proposed standard. EPA decided not to gather more recent data on emission levels, because these emission levels are expected to change, and gathering the data would take considerable time both on the part of EPA and on the part of industry. Since the purpose of the standard is to minimize emissions, these more current data would not affect the standard itself. The 1974 emission levels were also used in diffusion modeling to project maximum ambient air concentrations around uncontrolled plants. These maximum air concentrations would probably be lower if 1976 emission levels were used. This would reduce the relative impact of the standard below that described in the *Standard Support and Environmental Impact Statement*, but would not affect the basis of the standard itself.

(2) *Approach for Regulating Vinyl Chloride Under Section 112.* Two approaches other than using best available control technology were suggested by the commenters for regulating vinyl chloride under section 112. The first was to ban polyvinyl chloride products for which substitutes are currently available and to gradually phase out other polyvinyl chloride products as substitutes are developed.

In the preamble to the proposed standard EPA specified its reasons for not setting a zero emission limit for vinyl chloride, as follows: (1) There are beneficial uses of vinyl chloride products for which desirable substitutes are not readily available; (2) there are potentially adverse health and environmental impacts from substitutes which have not been thoroughly studied; (3) there are a number of employees, particularly in the fabrication industries, who would become at least temporarily unemployed; and (4) control technology is available which is capable of substantially reducing emissions of vinyl chloride into the atmosphere.

EPA agrees that substitutes do exist or could be manufactured for most polyvinyl chloride uses. However, in general, these substitutes do not have some of the more desirable characteristics of polyvinyl chloride, such as nonflammability. If vinyl chloride and polyvinyl chloride were banned, other substitutes with these more desirable characteristics would likely be developed. There is a risk that these substitutes would also have adverse health or environmental effects. Since control measures are available which can reduce vinyl chloride emissions by 90 percent or more, it does not seem prudent to reduce emissions by the remaining percentage and take the risk of introducing new untested chemicals into the environment.

Another approach suggested by the commenters was to base the standard for each individual emission point on cost versus benefit. Several of the fugitive emission sources were named specifically as ones for which the costs of control were substantially higher than the benefits. Although EPA did determine a cost-benefit ratio for the controls required for a number of emission points, EPA does not believe such a ratio is an appropriate basis on which to set a standard. Section 111 of the Clean Air Act provides for the development of standards based on best control technology (considering costs). Even under section 111, however, standards are not based on a fine balancing of costs versus benefits. Instead, costs are considered in terms of the affordability of the control technology required to achieve a given emission level and the economic impact of possible standards on the industry in question. Unlike section 111, section 112 does not explicitly provide for consideration of costs, so it would clearly be inappropriate to consider costs to a greater extent under section 112 than would be done under section 111. As discussed in the preamble to the proposed standard for vinyl chloride, EPA believes costs may be considered under section 112, but only to a very limited extent; i.e., to assure that the costs of control technology are not grossly disproportionate to the amount of emission reduction achieved. In comparison with other emission points, the costs of controlling the fugitive emission sources mentioned by the commenters are relatively small compared with the amount of emission reduction achieved.

Several commenters recommended adding to the regulation a provision for excess emissions during startup, shutdown, and malfunction. EPA considered this comment, and decided that this addition is not necessary for the vinyl chloride standard. Startup and shutdown of the process has essentially no effect on emissions to the atmosphere for polyvinyl chloride production, and technology exists to avoid excess emissions during startup and shutdown at ethylene dichloridevinyl chloride plants. We do not believe plants should be allowed to emit excess emissions during malfunctions, and therefore are requiring them to shut down immediately.

(3) *Selection of source categories.* In the preamble to the proposed standard EPA recognized that some small research and development facilities may exist where the emissions of vinyl chloride are insignificant and covering these facilities under the standard would be unnecessary and inappropriate. However, EPA did not have sufficient information available to clearly define which facilities should be excluded from the standard, and encouraged interested parties to submit such information during the comment period. Based on the information submitted, EPA decided to exempt polyvinyl chloride reactors and associated equipment from applicability of all parts of the standard if the reactors are used in research and development and have a capacity of no more than 0.19 m^3 (50 gal). Reactors in this size range can generally be found in a laboratory, whereas the larger reactors are typically pilot scale facilities. Emissions from laboratory scale equipment are relatively small, and application of the controls required by the standard would be expensive and impractical. EPA also decided to exempt research and development facilities containing reactors greater than 0.19 m^3 (50 gal) and no more than 4.07 m^3 (1100 gal) in capacity from all parts of the standard except the 10 ppm limit for reactors, strippers, monomer recovery systems, and mixing, weighing and holding containers. EPA decided not to require these facilities to meet other parts of the standard because of the technical problems involved in doing so. For example, the standard for reactor opening is based in part on reducing the frequency of opening the reactor. Research and development reactors have to be opened after every batch for thorough cleaning. Also, stripping technology is developed individually for each resin in research and development equipment. Therefore, attainment of the stripping limitations in the research and development equipment would not always be possible. The 4.07 m^3 (1100 gal) figure was selected as an upper cut-off point because there are no commercial reactors smaller than this.

(4) *Emission limits.* The only major change in the emission limits between proposal and promulgation is the addition of a provision for emergency manual venting of vinyl chloride from reactors to the atmosphere. The proposed standard prohibited all manual venting to the atmosphere. In the preamble to the proposed standard, EPA invited interested persons to comment on whether permitting manual venting to the atmosphere could result in overall lower emissions. There are several methods available for preventing relief discharges from reactors, one of which is manual venting of part of the reactor contents for purposes of cooling and reduction in pressure within the reactor. The higher the temperature and pressure within the reactor, the greater the amount of vinyl chloride which has to be removed to bring the reactor under control. Manual venting can be done at a lower pressure than the pressure required to open the relief valve. For this reason manual venting can result in lower emissions than would occur by allowing the reactor to discharge through the relief valve. Furthermore, a manual vent valve is under the control of an operator and can be closed. A relief valve may become clogged with resin and not close. The result would be loss of all the reactor contents.

The contents of a reactor can be manually vented to a gasholder or other holding vessel. However, in some cases, such as during severe weather conditions, several reactors may be out of control at one time. There would be insufficient holding capacity under these conditions to manually vent the contents of all the reactors to a gasholder. Therefore, when all other measures to prevent relief valve discharges have been exhausted, manual venting will be permitted as a last resort before the relief valve opens. The same notification procedures are required for manual venting to the atmosphere as are required for relief discharges.

There are several changes in the numerical emission limits in the promulgated standard. Except for the standard for reactor opening loss, these changes simply involve conversion to the International System of Units (SI). There was an error involved in the original calculation used to derive the standard for reactor opening. Correcting this error doubles the allowable emissions. It is emphasized that the change in this standard is a correction, and not a change in the intent for the degree of control required.

The proposed standard required the installation of a rupture disc beneath each relief valve to prevent leakage from the relief valve. A provision has been added to the promulgated standard so that a rupture disc is not required if the relief valve is tied into a process line or recovery system. In this case, any leakage from the relief valve would be contained.

The regulation for obtaining vinyl chloride samples has been changed to an operating procedure. The proposed standard stated that there were to be no emissions from taking the samples. Several commenters pointed out that the use of the word "no" would make this regulation impractical to enforce. Therefore, the promulgated standard specifies the operating procedure which EPA originally intended to be used to control this source. This revision is only a change in wording and does not represent a change in the level of the standard.

The regulation for taking samples has also been revised to apply only to samples containing at least 10 percent by weight vinyl chloride. This is consistent with the other parts of the standard which apply to equipment "in vinyl chloride service." "In vinyl chloride service" distinguishes between situations where vinyl chloride is clearly involved and situations where vinyl chloride is a minor component or contaminant, and as defined in promulgated § 61.61(1) means that a piece of equipment contains or contacts either a liquid that is at least 10 percent by weight vinyl chloride or a gas that is at least 10 percent by volume vinyl chloride.

The proposed standard required a vinyl chloride monitoring system for continuously measuring vinyl chloride levels both within the plant (for leak detection) and within stacks. The proposed standard did not outline required specifications for the monitoring system, except that it was to analyze the samples with gas chromatography, or if all hydrocarbons were assumed to be vinyl chloride, with infrared spectrophotometry, flame ion detection, or equivalent. It required that each plant submit a description of its monitoring system to EPA, so that EPA could determine whether it was acceptable or not. Comments were received indicating a need for EPA to specify some criteria for judging the acceptability of monitoring systems. The accuracy of the monitoring system would be related to the frequency of calibration. Therefore, EPA has included in the promulgated standard requirements for the frequency of calibration and procedures to be carried out in the calibration of the monitoring instruments.

The portable hydrocarbon detector required by the proposed standard was required to have a sensitivity of 5 ppm. Comments were received indicating that instruments in this sensitivity range are delicate and require continuing maintenance. The portable hydrocarbon detector is required for leak detection and for measuring vinyl chloride concentrations inside the equipment before opening it. A 5 ppm sensitivity is not needed in either case, and the required sensitivity has been changed to 10 ppm in the promulgated standard.

The proposed standard contained a single regulation for compressors. The promulgated standard has separate regulations for rotating and reciprocating compressors. This is consistent with having separate regulations for rotating and reciprocating pumps in both the proposed and promulgated standards.

Section 61.66 of the proposed standard provided for the use of equivalent methods of control which have been approved by EPA. The promulgated standard requires that the plant owner or operator submit a request for determination of equivalency within 30 days of the promulgation date if the alternative control method is intended as the initial means of control. The purpose of this is to provide time for EPA to evaluate the method before the plant has to be in compliance (for existing sources, 90 days after the promulgation date). EPA also suggests that this request for determination of equivalency be accompanied by a request for waiver of compliance pursuant to section 112(c)(1)(B)(ii) of the Act. The request for a waiver for compliance should provide for the case where EPA determines that a method is not equivalent and the plant needs to purchase other equipment. In no case will the waiver of compliance be extended beyond two years from the date of promulgation.

There are several wording clarifications which have been made in the promulgated standard. The definition for "in vinyl chloride service" (§ 60.61(1)) has been clarified by stating that it means equipment that contacts vinyl chloride as well as equipment that contains vinyl chloride. This would include such equipment as agitators.

Words have been added in §§ 61.62, 61.63, and 61.64 to clarify that the 10 ppm emission limits do not have to be met when equipment has already been opened in compliance with the regulation for opening of equipment. Equipment that has met the opening of equipment regulation can contain more than 10 ppm vinyl chloride and would be in violation of the standard if this statement were not included.

The requirements for stripping polyvinyl chloride resins to specified levels have been revised in §§ 61.64(e), 61.67(g)(3)(ii), and 61.70(c)(2)(i) so that measurement of the vinyl chloride levels in the resins is to be made immediately after stripping is completed rather than as the resin is being transferred out of the stripper. This allows a plant to carry out operations in a stripper after stripping has been completed but before it is transferred out of the stripper. This is consistent with the original intent of the standard.

The regulation for loading and unloading lines in § 61.65(b)(1) has been revised to clarify that it applies only to lines that are disconnected after each loading or unloading operation. Permanently installed pipelines that are opened infrequently for inspection or maintenance, for example, are covered by the opening of equipment regulation rather than the loading and unloading line regulation.

The regulation for inprocess wastewater in the proposed standard could have been misinterpreted to require individual treatment of wastewater streams. Section 61.65(b)(9)(i) of the promulgated standard clarifies that wastewater streams that are required to be treated (i.e., those containing greater than 10 ppm vinyl chloride) can be combined to be treated. However, wastewater streams that contain greater than 10 ppm vinyl chloride cannot be combined with wastewater streams that contain less than 10 ppm vinyl chloride before treatment; i.e., dilution cannot be used to meet the standard.

The commenters recommended several changes in the emission limits which have not been incorporated into the promulgated standard. These are discussed in the following paragraphs.

It was recommended that the requirement for double mechanical seals on pumps, compressors, and agitators be removed because the single seals currently used on this equipment have small emissions and are more reliable than double mechanical seals. EPA is aware that each fugitive emission source, such as one pump, taken by itself causes relatively small emissions. Fugitive emissions considered as a whole are a significant source of emissions, however, and the intent of the standard is to reduce these. Double mechanical seal pumps are commonly used in the industry for emission reduction. Sealless pumps or equivalent systems are available as options to double mechanical seals.

The commenters recommended increasing the averaging time for the 10 ppm limits and the emission limits for reactor opening and stripping to 30 days. Some of the commenters apparently thought that the 10 ppm limits had to be met on an instantaneous basis. However, since the performance test for determining compliance consists of three runs for a minimum of an hour each, the averaging time for the 10 ppm limit is at least three hours. Increasing the averaging time to 30 days for any of the emission limits would permit higher peak emission levels. EPA has determined that this is neither desirable nor necessary.

Some commenters requested that the stripping levels for dispersion resins be made the same as for other resins and others requested that they be made less stringent. EPA decided not to make the standard for stripping dispersion resins the same as for other resins because there is sufficient evidence to indicate that these resins are more difficult to strip than other resins. With regard to making the stripping levels for dispersion resins less stringent, only one of the eight manufacturers of dispersion resins specifically commented that the dispersion resin standard should be made less stringent. Only two of several grades of dispersion resins made by this company cannot meet the 2,000 ppm limit. The proposed standard takes into consideration that some resins are more difficult to strip than others by providing for averaging among different resins.

(5) *Testing, reporting, and recordkeeping.* There are several relatively minor changes in the testing, reporting, and recordkeeping requirements. A provision has been added to § 61.67 which requires that stack gas samples taken with Test Method 106 are to be analyzed within 24 hours. This is consistent with the requirements in the proposed Test Method 106. The promulgated standard also specifies that in averaging the results of the three runs required by Test Method 106, a time-weighted average is to be used.

One commenter requested that the oxygen content and moisture content be specified for the 10 ppm concentration standards. The proposed standard specified that the vinyl chloride concentration is to be corrected to 10 percent oxygen (wet basis) if combustion is used as the control measure. In the promulgated standard, this requirement has been expanded to all control measures.

A provision has been added to the promulgated standard which states that if a reactor is also used as a stripper, the reactor opening emissions may be determined immediately following the stripping operation. If a reactor is also used as a stripper, the resin is in the reactor when it is opened. This means that vinyl chloride in the resin which has already been stripped to acceptable levels can escape from the resin and become part of the reactor opening loss. It is EPA's intent that once a resin has been stripped to the required levels, that additional controls are not required. Under the new provision, vinyl chloride escaping from the resin after it has been stripped to acceptable levels is not counted as part of the reactor opening loss.

A section requiring continuous monitoring of stack emissions has been added to the promulgated standard. The continuous monitoring of stack emissions was required in the proposed standard. The addition of a specific paragraph for emission monitoring serves only to clarify the requirement.

The standard has been revised so that the initial report requires a "description" rather than a "detailed description" of the equipment used to control fugitive emissions. Several commenters pointed out that a detailed description would contain proprietary information. EPA agrees that a detailed description in the initial report is unnecessary. If additional information is needed, EPA can obtain it under section 114 of the Act and the plant can request confidential treatment in accordance with 40 CFR Part 2 for information it believes to be proprietary.

The proposed standard required that a semiannual report be submitted every 180 days. The promulgated standard specifies dates for the submittal of the reports. It also specifies that the first semiannual report does not have to be submitted until at least six months after the initial report is submitted.

The standard has been revised to eliminate the requirement to record the cause of any leak detected by the vinyl chloride detector, the action taken to repair the leak, and the amount of time required to repair the leak. EPA is concerned only that leaks are detected and repaired. That this has been done can be established by looking at the strip chart record of measurements made by the vinyl chloride detector. These records are still required for the portable hydrocarbon detector however.

Several commentators recommended that the companies be allowed an extra two weeks to submit to EPA data from the initial performance test. They also recommended that they submit the data by regular mail rather than registered mail. EPA has not adopted either of these recommendations. A source is supposed to be in compliance with the standard within 90 days of the promulgation of the standard. The standard requires that the emission tests be done within the 90 day period, and permits an extra 30 days for determination of results. The purpose of using registered mail is to document the fact that emission data have been sent and received. This way if the results are lost in the mail, there will be no question that they were sent.

(6) *Test method.* Test Method 106 has been changed to recognize that on a gas chromatograph equipped with a Chromosorb 102 column, acetaldehyde may interfere with the vinyl chloride peak. When a sample is expected to contain acetaldehyde, a secondary column as described in section 4.3.2 must be employed. Mass spectroscopy or another absolute analytical technique is required to confirm the vinyl chloride peak obtained with the gas chromatograph, only if peak resolution with the secondary column is not successful.

In section 4.1.4, aluminized Mylar bags can be substituted for Tedlar bags. EPA now has data to allow this substitution, provided that the samples are analyzed within 24 hours of collection.

In section 5.1.3 of Test Method 106 the requirement to use "oxygen gas" has been replaced with "oxygen gas or air, as required by the detector." Several commentors stated that most gas chromatographs are designed to use hydrogen and air for their flame detectors. When used in this way, they are capable of detecting 0.5 ppm vinyl chloride in air. This is sensitive enough for monitoring the 10 ppm emission limits stipulated in the standard.

In section 6.4 of Test Method 106 the requirement for an automatic integrater has been replaced with a requirement for a disc integrator or planimeter for measuring peak area. This change is in response to a comment which states that automatic integrators are unnecessarily elaborate and expensive.

A new section 6.5 has been added to Test Method 106 which requires determination of the water vapor content of the sampling bag by measuring the ambient temperature and pressure near the bag. The vinyl chloride concentration of the bag can then be reported on a dry basis. A provision for checking the rigid container for leaks has been added to section 7.4 of Test Method 106.

The only change in Test Method 107 is the provision in Section 5.3.2 for use of Carbopak C as well as Carbopak A.

AUTHORITY: Section 112 of the Clean Air Act as added by sec. 4(a) of Pub. L. 91-604, 84 Stat. 1685 (42 U.S.C. 1857c-7; Section 114 of the Clean Air Act, as added by sec. 4(a) of Pub. L. 91-604, 84 Stat. 1687, and amended by Pub. L. 93-319, sec. 6(a)(4), 88 Stat. 259 (42 U.S.C. 1857c-9); Section 301(a) of the Clean Air Act, as amended by sec. 15(c)(2) of Pub. L. 91-604, 84 Stat. 1713 (42 U.S.C. 1857g(a))).

Dated: October 1[illegible] 76.

JOHN QUARLES,
Acting Administrator.

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 61]

[FRL 728-5]

VINYL CHLORIDE

National Emission Standards for Hazardous Air Pollutants

AGENCY: Environmental Protection Agency.

ACTION: Proposed rule.

SUMMARY: The proposed amendments are being made to the vinyl chloride standard which has promulgated October 21, 1976, and would apply to new and existing ethylene dichloride, vinyl chloride, and polyvinyl chloride plants. The standard and the proposed amendments implement the Clean Air Act and are based on the Administrator's determination that vinyl chloride is a hazardous air pollutant. The intended effect of the proposed amendments is to require improved effectiveness of control technology at existing plants, impose more stringent emission limits on new sources, and prohibit an emission increase within the vicinity of an existing source due to the construction of a new source.

DATES: Comments must be received on or before August 1, 1977.

ADDRESSES: Comments should be submitted (preferably in triplicate) to the Emission Standards and Engineering Division, Environmental Protection Agency, Research Triangle Park, North Carolina, Attention: Mr. Don R. Goodwin.

All public comments received may be inspected and copied at the Public Information Reference Unit (EPA Library), Room 2922, 401 M Street, SW., Washington, D.C.

FOR FURTHER INFORMATION CONTACT:

Don R. Goodwin, Emission Standards and Engineering Division, Environmental Protection Agency, Research Triangle Park, North Carolina 27711, Telephone No. 919-688-8146, ext. 271.

SUPPLEMENTARY INFORMATION:

BACKGROUND

On October 21, 1976, EPA promulgated a standard for vinyl chloride under the authority of section 112(b)(1)(B) of the Clean Air Act, as amended (41 FR 46561). The standard applies to ethylene dichloride, vinyl chloride, and polyvinyl chloride plants.

On November 19, 1976, the Environmental Defense Fund (EDF) petitioned the United States Court of Appeals for the District of Columbia Circuit to review the standard. Motions to intervene were subsequently filed on behalf of the Society of the Plastics Industry, Inc., the Goodyear Tire and Rubber Company and Air Products and Chemicals, Inc., and were granted by order of the Court on January 18, 1977. On March 24, 1977, EDF and EPA moved to dismiss the proceedings in view of a settlement agreement requiring EPA to take certain additional actions. These incluue a restatement of EPA's policy for regulating carcinogens under section 112 of the Clean Air Act; the proposal of amendments which would require increased efficiency of existing control equipment, require more stringent control at new sources, and prohibit increases in emissions within the vicinity of an existing source due to new construction; and the initiation of a review of the vinyl chloride standard three years after the promulgation of the amendments.

ZERO EMISSION GOAL

The vinyl chloride standard has been criticized for allegedly placing unwarranted emphasis on technological rather than health considerations. Although EPA disagrees with this criticism, it seems appropriate to restate EPA's approach to the regulation of carcinogens in general and under Section 112 of the Clean Air Act, and to explain how the vinyl chloride standard and the proposed amendments are consistent with this approach and with the protection of public health.

On May 25, 1976, EPA published interim procedures and guidelines for health risk and economic impact assessments of suspected carcinogens (41 FR 21402), which define EPA's approach to regulatory action for suspect carcinogens. As indicated in that publication, there are two steps involved in the decision-making process with regard to the regulation of a potential carcinogen. Although different EPA statutory authorities impose different requirements, in general two decisions must be made with regard to each potential carcinogen. The first decision is whether a particular substance constitutes a cancer risk. The second decision is what regulatory action, if any, should be taken to reduce that risk.

In deciding whether a cancer risk exists, EPA will consider a substance a presumptive cancer risk when it causes a statistically significant excess incidence of benign or malignant tumors in humans or animals. In the case of vinyl chloride, EPA evaluated all available data and concluded that a cancer risk exists. In deciding how and whether to regulate, EPA examined section 112 of the Clean Air Act. Section 112 of the Act requires that emission standards be set "at the level which in the judgment of the Administrator provides an ample margin of safety to protect the public health from such hazardous air pollutants." This requirement appears to assume that each pollutant regulated will have a threshold level of effects below which no health effects will occur. As explained in the documentation for the current standard (40 FR 59532, December 24, 1975; 41 FR 46560, October 21, 1976), it has not been possible to determine if there is a threshold level of effects for vinyl chloride and it is not certain that such a threshold may be determined in the near future. In the absence of strong evidence to the contrary, then, the only level of vinyl chloride which would appear to be absolutely protective of health is zero, which may be achievable only by banning vinyl chloride emissions completely. That, in turn, would require closing the entire industry. As explained in the earlier rulemaking it is not clear that Congress would have intended this result, so instead EPA required the lowest level achievable using technological means. (See 40 FR 59534 and 41 FR 46562).

In order to insure that the standard continues to approach the only level of emissions which is known to be absolutely protective of health, namely zero emissions, EPA is proposing amendments which require more efficient use of existing control technology at existing plants and more effective controls at new plants, and which encourage technology to reach this goal without banning vinyl chloride.

MORE STRINGENT STANDARDS FOR EXISTING SOURCES

EPA is proposing amendments which would require sources presently subject to a 10 ppm emission limit to reduce emissions to 5 ppm within three years of promulgation of the amendments. The affected sources include ethylene dichloride purification; vinyl chloride formation and purification; reactors, strippers; mixing, weighing, and holding containers; monomer recovery systems; and fugitive emissions which have been captured in accordance with the existing regulation.* If the owner or operator of a source believed that a control system would not be capable of meeting the 5 ppm limit, he would be able to request that the Administrator approve an interim emission limit for that source. Such requests would have to be made one year before the compliance date. In requesting an interim emission limit, the owner or operator would have to submit supportive data and meet with EPA to discuss his particular problems in attaining compliance. The meeting would be announced in the FEDERAL REGISTER and any interested party would be allowed to attend and submit written or oral comments. If an interim emission limit were granted to the source, the required emission level would be specified in a written notification from EPA and in the FEDERAL REGISTER. Each source granted an interim emission limit would be reviewed every three years to determine whether emissions could be reduced to 5 ppm, or at least to a lower interim emission limit.

In proposing the reduction from 10 to 5 ppm, it is not EPA's intent that a control system which has been installed to meet the 10 ppm emission limit be removed and replaced with another more efficient control system or that a second control system be added behind the first control system. The purpose of the proposed amendment is to force owners and operators to maximize the effectiveness of existing control systems.

---

*As an explanatory note, paragraph (b) of § 61.65 contains nine fugitive emission regulations. For several of these, the fugitive emissions are required to be captured and ducted to a control device meeting 10 ppm. According to the proposed amendments, the emissions from this control device would have to be reduced to 5 ppm in the same way any other source currently required to meet 10 ppm would have to do. Rather than incorporating both the 5 and 10 ppm emission limits in each paragraph in § 61.65(b), a separate paragraph (c) containing these emission limits is being added to § 61.65. All the other paragraphs in (b) are cross-referenced in paragraph (c).

MORE STRINGENT STANDARDS FOR NEW SOURCES

The proposed amendments would also require more stringent controls for new sources; i.e., sources for which construction is commenced after the date of proposal of these amendments. According to § 61.02 of the General Provisions, "commenced" means that an owner or operator has undertaken a continuous program of construction or modification or that an owner or operator has entered into a contractual obligation to undertake and complete, within a reasonable time, a continuous program of construction or modification.

New sources of types which would be subject to the 10 ppm emission limit under the current standard would be required under the amendments to meet a 5 ppm emission limit at the time of startup. With new sources there would be no provision allowing requests for EPA approval of an interim emission limit. New sources would be required to meet the more stringent emission limit at the time of startup, because they have an opportunity to design their equipment to meet the 5 ppm emission limit at the time construction is commenced. Existing sources, on the other hand, require time to maximize the effectiveness of their control systems.

The proposed amendment would also require ethylene dichloride-vinyl chloride plants to control emissions from new oxychlorination reactors to 5 ppm. This requirement is based on installation of a recycling and oxygen feed system with an incinerator or equivalent control device. The current standard limits emissions from the oxychlorination reactor to 0.2 g/kg (0.0002 lb/lb) of the 100 percent ethylene dichloride product from the oxychlorination reactor. This emission limit can be met by changing process parameters, rather than installing a control device. During the development of the current standard EPA considered requiring existing sources to control emissions with an incinerator or equivalent technology, but rejected this approach because a large quantity of fuel would be required to reduce emissions from a relatively small source. An existing oxychlorination reactor typically has a large volume, low hydrocarbon effluent gas stream, and large quantities of supplemental fuels would be required for combustion of its emissions.

A new plant can reduce the volume of its effluent gas stream and make it more concentrated by recycling the gas stream and using oxygen instead of air to feed into the process. (*3*, *4*) the current standard was not based on this technology because it was not considered feasible to retrofit existing plants so that they could use oxygen instead of air. The recycling and oxygen feed methodolgy is considered feasible for new oxychlorination reactors because it can be incorporated at the time of construction. Since the use of this technology would eliminate the supplemental fuel problem referred to above, it is EPA's judgment that new oxychlorination reactors should be controlled to the same extent that is proposed for other emission sources.

The proposed amendment also includes a more stringent emission limit for new polyvinyl chloride resins being processed in equipment following the stripping operation. That is, the amendment would apply to resins for which production for the purpose of marketing was commenced after the proposal of the amendment. The amendment would require all new resins except new dispersion resins to be stripped to 100 ppm and new dispersion resins to be stripped to 500 ppm. These limits for new products would be one-fourth of the limits contained in the standard for existing products. Consistent with the current standard, the amendment would permit the use of control devices rather than stripping technology to meet the emission limit. In this case equipment being used to process all new resins except new dispersion resins would have to be controlled to 0.01 kg/kg product and the equipment used for new dispersion resins would have to be controlled to 0.05 kg/kg product.

A "new source" is defined in 40 CFR 61.02 as a stationary source, the construction or modification of which is commenced after proposal of a standard. There was some question based on this definition as to whether the amendment to the stripping standard for new sources should apply to new polyvinyl chloride resins or the installation of new equipment following the stripper. If the applicability of the amendment for new sources were based on the installation of new equipment following the stripper, it would be difficult to determine what constitutes a new source at an existing plant. This is based on the reasoning that the stripping standard requires that all equipment following the stripper in the process be controlled as a unit. The series of equipment following the stripper includes pumps and conveying equipment which might be expected to be replaced on a frequent and routine basis. Replacing one of these pieces of equipment would in effect cause the whole series of equipment following the stripper to have to meet the standard for new sources. In other words, all resins processed in the series of the equipment would have to meet the lower standard even though only a minor part of the equipment had been replaced.

EPA decided that a more reasonable and direct approach was to make the proposed amendment apply to the production of new polyvinyl chloride resins. This is based on the reasoning that emissions from the equipment following the stripper are a function of the amount of vinyl chloride left in the resin after the stripping operation is completed; i.e., the resin is the source of the emissions rather than the equipment. The same equipment can be used to process different resin grades. Variations in the emissions from the equipment are a function of the resin being processed rather than the characteristics of the equipment. The control technology which is used for the equipment following the stripper is likewise more directly linked to the resin than the equipment. Stripping is used to control the emissions due to the vinyl chloride in the resin before the resin is processed in the equipment.

Before the hazards of vinyl chloride became known, stripping technology was employed by polyvinyl chloride manufacturers to recover raw materials for economic purposes. As a result of a standard promulgated by the Occupational Safety and Health Administration (39 FR 35890), some companies investigated improvements in stripping methodology for emission control purposes. (*1*)

Optimum stripping consists of a set of operating conditions which must be developed experimentally on an individual basis for the many resins. In developing the current standard, EPA recognized that stripping technology for dispersion resins had not been refined to the same extent as it had been for other resins and that there was more difficulty in stripping dispersion resins than other resins. For this reason a less stringent emission limit was established for dispersion resins. Dispersion resins are permitted a higher emission limit under the proposed amendment for the same reason.

EPA believes that for some resins, companies have already developed stripping technology which would meet the proposed amendment. (*2*) For other resins, the proposed standard would require additional improvement in stripping technology. If stripping technology has not been developed to the extent necessary to meet the proposed amendment for a particular resin, the manufacturer would have the option of developing the technology or not producing the resin.

The current standard, unlike the proposed amendment, was not based on the premise that an owner or operator would have the option of not producing a particular resin. It is EPA's judgment that the owner or operator making a new product has more freedom of choice than the owner or operator already making a particular product in selecting those resins which are to be produced. EPA's standard would be included in the variables under consideration when decisions are being made as to which resins are to be produced.

The proposed amendment would apply to any new source, whether it constituted replacement of an existing source in an existing plant, the expansion of an existing plant, or part of an entirely new plant. That is, if a new oxychlorination reactor or a new polyvinyl chloride reactor were installed at an existing plant, it would be subject to the emission limits for new sources. This means that as existing sources are gradually replaced with new sources in an existing plant, the overall emission level from that existing plant would be reduced.

EMISSION OFFSET

Because the present vinyl chloride standard focuses on reducing emissions rather than attaining a particular ambient air quality concentration, there is no provision for limiting the size of plants or the clustering of plants in a geographical area. The doubling of the size of an existing plant or the construction of a new plant beside an existing plant would considerably increase the ambient air concentrations of vinyl chloride in the vicinity of the plant(s) even if the vinyl chloride standard was met. EPA determined at the time of promulgation of the current standard that the costs of prohibiting the production of vinyl chloride and polyvinyl chloride were too high and the continued operation of existing plants should be allowed. EPA believes, however, that the standard should include a mechanism for prohibiting an increase in ambient concentrations of vinyl chloride due to new construction in areas where existing sources are already located.

Accordingly, EPA is proposing an amendment which would prohibit an increase in emissions within 8 kilometers (km) (approximately five miles) of an existing source due to the construction of a new emission source. This means that if a new source were added to an existing plant, the increase in emissions due to that new source would have to be offset by a reduction in emissions from other existing sources within that plant or at other plants within 8 km of the construction site of the new source. Similarly, a new plant could not be constructed within 8 km of an existing plant(s) unless the emission increase due to the new plant were offset by an emission reduction at the existing plant or plants. This provision may result in few existing plants being expanded and few new plants being constructed in the vicinity of existing plants. However, the proposed amendment does not preclude this possibility.

The offset provision would apply only to new construction which results in an increase in production rate. Replacing or adding equipment such as pumps, compressors, agitators, sampling equipment and unloading hoses is a routine practice at existing plants. Additions of equipment of this nature would, in and of itself, be expected to result in little, if any, increase in emissions. In EPA's judgment, a plant should not be required to prove this fact each time one of these pieces of equipment is added. The addition of this type of equipment in conjunction with major process equipment, however, is likely to result in both an increase in emissions as well as an increase in production rate, and is therefore covered by the offset provision.

If the offset provision were adopted, the reduction in emissions could be achieved in the production rate of an existing source or sources. The baseline emission rate would be determined based on the maximum production rate which had been attained by each existing source. The allowable emission rate for each source would be based on the maximum production rate at which that source would be operated in the future.

Also, if the emissions from an existing source were already below the emission limit applicable to it, the proposed amendment would give the source credit for the difference between the emission limit and the actual emission level. That is the baseline emission rate would be based on the standard rather than on an emission test. It is EPA's judgment that this is a more equitable approach than penalizing a source which has already taken measures to reduce emissions below the standard. Such a source would have less room for further reducing emissions.

The emission limits applicable to both the existing and new sources involved in the offset arrangement would be contained in the approval of new construction granted by the Administrator under 40 CFR 61.08.

EPA believes that a policy of no net increase in emissions due to new construction is justified because of the hazardous nature of vinyl chloride. However, EPA recognizes the potential difficulties in implementing such a policy and interested persons are urged to submit comments and factual information relating to this policy.

REVIEW OF STANDARD

EPA plans to undertake a full-scale review of Subpart F of 40 CFR Part 61 beginning three years from the promulgation of any amendments. In the study EPA will review information concerning technological advances in the control of vinyl chloride emissions to determine what further changes might then be appropriate to move toward the goal of zero vinyl chloride emissions. EPA will also consider recent health data to determine whether the approach for regulating vinyl chloride should be altered.

ENVIRONMENTAL IMPACT

The proposed amendment, in contrast to the current standard, would encourage the development of new technology and improvements in existing technology and would have the following three positive environmental impacts: (1) further reduction of emissions at existing plants, (2) no increase in emissions within 8 km of an existing source, and (3) lower emissions from new sources than would be accomplished through the current standard regardless of the construction site. These environmental impacts would provide progress toward the ultimate goal of zero emissions without banning vinyl chloride, and in the process would provide additional protection of public health by further minimizing the health risks to the people living in the vicinity of existing plants and to any additional people who are exposed as a result of new construction.

Specifically, for those existing sources which are currently subject to a 10 ppm emission limit, emissions would be reduced by half within three years after the promulgation date of these amendments. At both an existing average-sized ethylene dichloride-vinyl chloride plant and an existing average-sized polyvinyl chloride plant, which contain other sources than the ones required to meet a 5 ppm emission limit, it is estimated this will have the effect of reducing total emissions by less than one percent. Emissions at existing plants would be further reduced as existing oxychlorination reactors are replaced with new oxychlorination reactors and as new polyvinyl chloride resins are preduced to replace existing ones.

Under the proposed amendment, emissions from new plants would be considerably lower than they would be under the current standard. For a typical new average-sized ethylene dichloride-vinyl chloride plant (318×10^6 kg/yr or 700 $\times10^6$ lb/yr produced), the hourly emissions would be 5.1 kg (11.5 lb) instead of 10.3 kg (23.1 lb). For a typical new average-sized dispersion polyvinyl chloride plant (46×10^6 kg/yr or 100×10^6 lb/yr production), the emissions would be about 9 kg/hr (20 lb/hr) instead of 17.5 kg/hr (39 lb/hr) and for a typical new average-sized suspension polyvinyl chloride (68×10^6 kg/yr or 150×10^6 lb/yr production) the emissions would be 13.5 kg/hr) (30 lb/hr) instead of 16 kg/hr (36 lb/hr). These emissions are calculated based on the emission factors published in the documentation for the existing standard. (*1*) Ambient air concentrations are expected to be reduced proportionately.

The only negative environmental impact would be an increase in hydrogen chloride emissions at ethylene dichloride-vinyl chloride plants if incineration were used to control emissions from new oxychlorination reactors. However, due to the corrosion problems which would otherwise occur on plant property and in the community, plants are expected to use scrubbers to control the hydrogen chloride emissions. The proposed amendment is not expected to have a significant impact on energy consumption.

ECONOMIC IMPACT

The potential economic impacts of the proposed standard are:

(1) Costs for research and development of improved methodology for operation of existing control technology so that it can be used to meet the 5 ppm emission limit.

(2) Costs for research and development of improved stripping techniques to meet the standard for new polyvinyl chloride resins.

(3) Cost of research and development or licensing for converting over to the oxygen system for a new oxychlorination reactor.

(4) Possibly increased transportation costs of raw materials in the case that the offset policy results in the construction of a new plant farther from an existing plant than it otherwise would have been.

(5) Costs of building a new plant more than 8 km from an existing plant in the event that the offset requirement precluded the expansion of an existing plant.

(6) Delay in the production of a particular resin due to time spent developing stripping technology for that resin.

(7) No growth in the production of a particular resin due to the inability to strip that resin to required levels.

The types of costs which have been named would be difficult to quantify. The costs would be expected to vary considerably from one plant to another depending on the amount of research and development than had already been done, the extent to which technology could be transferred from other plants and processes, and the plans for new construction.

One area in which cost estimates can be generated is the use of an oxygen-recycle oxychlorination process as opposed to an air-based system. The proposed amendment does not require the use of the oxygen-recycle system, but many plants would be expected to employ this system to avoid the high costs of incinerating the high volume gas stream from a typical air-based system. The primary cost of using the oxygen-recycle system is the cost of the oxygen itself. The cost of the oxygen for a particular plant would depend on whether the plant was located where there is a considerable demand for both the oxygen and nitrogen products of air separation. According to one recent article, if it is assumed that such a demand exists, the cost of the oxygen ($14.34/ton) would be approximately equivalent to the cost of compressing air for use in the air-based system. (1) Another report in which this assumption was not made and the economics of the air and oxygen systems were being compared, it was concluded that overall production economics "favor the oxygen process even if vent gas incineration would not be required for an air-based plant since the sum of all remaining advantages offered by oxygen-based plant operation more than outweighs the incremental cost for the oxygen feed." (2)

Miscellaneous: The Administrator invites comments on all aspects of the proposed amendments.

(Section 112 of the Clean Air Act, sec. 4(a) of Pub. L. 91-604, 84 Stat. 1685 (42 U.S.C. 1857c-7) and section 301(a) of the Clean Air Act, sec. 2 of Pub. L. No. 90-148, 84 Stat. 504 as amended by sec. (15) (c) (2) of Pub. L. 91-604, 84 Stat. 1713 (42 U.S.C. 1857 g(a)). Secs. 61.67 and 61.68 also proposed under the authority of section 114 of the Clean Air Act, as added by sec. 4(a) of Pub. L. 91-604, 84 Stat. 1687 and amended by Pub. L. 93-319, sec. 6(a)(4), 88 Stat. 259 (42 U.S.C. 1857c-9).)

NOTE.—The Environmental Protection Agency has determined that this document does not contain a major proposal requiring preparation of an Economic Impact Analysis under Executive Orders 11821 and 11949 and OMB Circular A-107.

Dated: May 27, 1977.

DOUGLAS M. COSTLE,
Administrator.

REFERENCES

(1) *Standard Support and Environmental Impact Statement: Emission Standard for Vinyl Chloride*, EPA-450 12-75-009, October, 1975.

(2) "Goodrich Reports Impressive Progress in Solving Vinyl Chloride Problem," *American Paint and Coatings Journal*, Vol. 60, No. 31, January 12, 1976, p. 24.

(3) E. W. Wimer and R. E. Feathers, "Oxygen Gives Low Cost VCM," *Hydrocarbon Processing*, March 1976, pp. 81-84.

(4) Peter Reich, "Air or Oxygen For VCM?," *Hydrocarbon Processing*, March, 1976, pp. 85-89.

It is proposed that Subpart F of 40 CFR Part 61 be amended as follows:

1. In § 61.08, paragraph (b) is revised to read as follows:

§ 61.08 Approval by the Administrator.

* * * * *

(b) If the Administrator determines that a stationary source for which an application pursuant to § 61.07 was submitted will not, if properly operated, cause emissions in violation of the standard or violation of § 61.73, he will approve the construction or modification of such source.

* * * * *

2. Section 61.62 is revised to read as follows:

§ 61.62 Emission standard for ethylene dichloride plants.

An owner or operator of an ethylene dichloride plant shall comply with the requirements of this section and § 61.65.

(a) Ethylene dichloride purification: Except as provided in § 61.65(a), the concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from any equipment used in ethylene dichloride purification is not to exceed the appropriate emission limit as follows:

(1) Each source for which construction had commenced on or before (date of proposal of these amendments), 10 ppm until (date three years after promulgation of these amendments) and 5 ppm after (date three years after the promulgation of these amendments).

(2) Each source for which construction commenced after June 2, 1977, 5 ppm.

(b) Oxychlorination reactor: Except as provided in § 61.65(a), emissions of vinyl chloride to the atmosphere are not to exceed the appropriate emission limit as follows:

(1) Each source for which construction had commenced on or before (date of proposal of these amendments), 0.2 g/kg (0.0002 lb/lb of the 100 percent ethylene dichloride product from the oxychlorination reactor.

(2) Each source for which construction commenced after June 2, 1977, 5 ppm.

(c) The requirements of this section do not apply to equipment that has been opened, is out of operation and met the requirement in § 61.65(b)(6)(i) before being opened.

3. Section 61.63 is revised to read as follows:

§ 61.63 Emission standard for vinyl chloride plants.

An owner or operator of a vinyl chloride plant shall comply with the requirements of this section and § 61.65.

(a) Vinyl chloride formation and purification: Except as provided in § 61.65(a), the concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from any equipment used in vinyl chloride formation and/or purification is not to exceed the appropriate emission limit as follows:

(1) Each source, for which construction had commenced on or before June 2, 1977, 10 ppm until (date three years after promulgation of these amendments) and 5 ppm after (date three years after promulgation of these amendments).

(2) Each source for which construction commenced after June 2, 1977, 5 ppm.

(b) The requirements of this section do not apply to equipment that has been opened, is out of operation, and met the requirement in § 61.65(b)(6)(i) before being opened.

4. Section 61.64 is amended by revising paragraphs (a)(1), (b), (c), (d) and (e) and by adding paragraph (f) as follows:

§ 61.64 Emission standard for polyvinyl chloride plants.

An owner or operator of a polyvinyl chloride plant shall comply with the requirements of this section and § 61.65.

(a) Reactor: The following requirements apply to reactors:

(1) Except as provided in paragraph (a)(2) of this section and § 61.65(a), the concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each reactor is not to exceed the appropriate emission limit as follows:

(i) Each source for which construction had commenced on or before June 2, 1977 10 ppm until (date three years after promulgation of these amendments) and 5 ppm after (date three years after promulgation of these amendments).

(ii) Each source for which construction commenced after June 2, 1977, 5 ppm.

* * * * *

(b) Stripper: Except as provided in § 61.65(a), the concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each stripper is not to exceed the appropriate emission limit as follows:

(1) Each source for which construction had commenced on or before June 2, 1977 10 ppm until (date three years after promulgation of these amendments) and 5 ppm after (date three years after final promulgation of these amendments).

(2) Each source for which construction commenced after June 2, 1977, 5 ppm.

(c) Mixing, weighting, and holding containers: Except as provided in § 61.65(a), the concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each mixing, weighing, or holding container in vinyl chloride service which precedes the stripper (or the reactor if the plant has no stripper) in the plant process flow is not to exceed the appropriate emission limit as follows:

(1) Each source, for which construction had commenced on or before (date

of proposal of these amendments), 10 ppm until (date three years after promulgation of these amendments) and 5 ppm after (date three years after promulgation of these amendments).

(2) Each source for which construction commenced after June 2, 1977, 5 ppm.

(d) Monomer recovery system. Except as provided in § 61.65(a), the concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each monomer recovery system is not to exceed the appropriate concentration as follows:

(1) Each source for which construction had commenced on or before (date of proposal of these amendments), 10 ppm until (date three years after promulgation of these amendments) and 5 ppm after (date three years after promulgation of these amendments).

(2) Each source for which construction commenced after June 2, 1977, 5 ppm.

(e) Sources following the stripper(s): The following requirements apply to emissions of vinyl chloride to the atmosphere from the combination of all sources following the stripper(s) [or the reactor(s) if the plant has no stripper] in the plant process flow including, but not limited, to centrifuges, concentrators, blend tanks, filters, dryers, conveyor air discharges, baggers, storage containers, and inprocess wastewater.

(1) In polyvinyl chloride plants using stripping technology to control vinyl chloride emissions:

(i) For a grade or grades of polyvinyl chloride resin which have been produced by the plant on or before June 2, 1977, the weighted average residual vinyl chloride concentration in all the grades processed through the stripping operation on each calendar day, measured immediately after the stripping operation is completed, may not exceed the appropriate emission limit as follows:

(A) 2,000 ppm for polyvinyl chloride dispersion resins, excluding latex resins;

(B) 400 ppm for all other polyvinyl chloride resins, including latex resins, averaged separately for each type of resin;

(ii) For a grade or grades of polyvinyl chloride resin which have not been produced by the plant on or before June 2, 1977, the weighted average residual vinyl chloride concentration in all the grades processed through the stripping operation on each calendar day, measured immediately after the stripping operation is completed, may not exceed the appropriate emission limit as follows:

(A) 500 ppm for polyvinyl chloride dispersion resins, excluding latex resins;

(B) 100 ppm for all other polyvinyl chloride resins, including latex resins, averaged separately for each type of resin; or

(2) In polyvinyl chloride plants controlling vinyl chloride emissions with technology other than stripping or in addition to stripping:

(i) For sources being used to process a grade or grades of polyvinyl chloride resin all of which had been produced by the plant on or before June 2, 1977:

(A) 2 g/kg (0.003 lb/lb) product from the stripper(s) [or reactor(s) if the plant has no stripper(s)] for dispersion polyvinyl chloride resins, excluding latex resins, with the product determined on a dry solids basis;

(B) 0.4 g/kg (0.004 lb/lb) product from the stripper(s) (or reactor(s) if the plant has no stripper(s)) for all other polyvinyl chloride resins, including latex resins, with the product determined on a dry solids basis.

(ii) For sources being used to process any grade of polyvinyl chloride resin not produced by the plant on or before June 2, 1977:

(A) 0.5 g/kg (0.0005 lb/lb) product from the stripper(s) (or reactor(s) if the plant has no stripper(s)) for dispersion polyvinyl chloride resins, excluding latex resins, with the product determined on a dry solids basis;

(B) 0.1 g/kg. (0.0001 lb/lb) product from the strippers (or reactor(s) if the plant has no stripper(s)) for all other polyvinyl chloride resins, including latex resins, with the product determined on a dry solids basis.

(f) The requirements of paragraphs (b), (c), and (d) of this section do not apply to equipment that has been opened, is out of operation, and met the requirement in § 61.65(b)(6)(i) before being opened.

5. Section 61.65 is amended as follows:

A. By replacing the phrase "10 ppm" with the phrase "the appropriate emission limit specified in § 61.65(c)" in paragraphs (b)(1)(ii), (b)(2), (b)(3)(i), (b)(3)(ii), (b)(3)(iii), (b)(3)(iv), (b)(3)(v), (b)(5), (b)(6)(ii), and (b)(9)(ii);

B. By revising paragraph (c) and adding paragraph (d) as set forth below.

§ 61.65 Emission standard for ethylene dichloride, vinyl chloride, and polyvinyl chloride plants.

* * * * *

(c) The emission limit which is not to be exceeded is as follows: (1) Each source, for which construction had commenced on or before June 2, 1977, 10 ppm until (date three years after promulgation of these amendments) and 5 ppm after (date three years after promulgation of these amendments).

(2) Each source for which construction commenced after June 2, 1977, 5 ppm.

(d) The requirements in paragraphs (b)(1), (b)(2), (b)(5), (b)(6), (b)(7) and (b)(8) of this section are to be incorporated into a standard operating procedure, and made available upon request for inspection by the Administrator. The standard operating procedure is to include provisions for measuring the vinyl chloride in equipment $\geq$4.75 m^3 (1250 gal) in volume for which an emission limit is prescribed in § 61.65(b)(6)(i) prior to opening the equipment and using Test Method 106, a portable hydrocarbon detector, or an equivalent or alternative method. The method of measurement is to meet the requirements in § 61.67(g)(5)(i)(A) or (g)(5)(i)(B).

6. In § 61.67, paragraph (a) is revised to read as follows:

§ 61.67 Emission tests.

(a) Unless a waiver of emission testing is obtained under § 61.13, the owner or operator of a source to which this subpart applies shall test emissions from the source as follows:

(1) For an existing source or a new source which has an initial startup date preceding October 21, 1976:

(i) Within 90 days following October 21, 1976, and

(ii) For those sources subject to §§ 61.62(a); 61.63(a); 61.64 (a)(1), (b), (c), and (d); and/or 61.65(b)(1), (b)(2), (b)(3), (b)(5), (b)(6), and/or (b)(9), within 90 days following (date three years after the promulgation date of these amendments).

(2) For a new source for which initial startup occurs after October 21, 1976, within 90 days of startup.

* * * * *

7. In § 61.68, paragraph (c) is revised to read as follows:

§ 61.68 Emission monitoring.

* * * * *

(c) A daily span check is to be conducted for each vinyl chloride monitoring system used. For all of the sources listed in paragraph (a) of this section, except for the one for which an emission limit is prescribed in § 61.62(b)(1), the daily span check is to be conducted with a concentration of vinyl chloride equal to the concentration emission limit applicable to it. For a source subject to the emission limit prescribed in § 61.62(b)(1), the daily span check is to be conducted with a concentration of vinyl chloride which is determined to be equivalent to the emission limit for that source based on the emission test required by § 61.67. The calibration is to be done with either:

* * * * *

8. A new § 61.72 is added to read as follows:

§ 61.72 Request for interim emission limit.

(a) If in the opinion of the owner or operator of an existing source, that source will be unable to comply with the 5 ppm emission limit in §§ 61.62(a)(1); 61.63(a)(1); 61.64 (a)(1)(i), (b)(1), (c)(1), (d)(1); and/or 61.65(c)(1) on or before (date three years after promulgation of these amendments), the owner or operator of that source may request that the Adminstrator approve an interim emission limit for that source. The request is to be in writing and is to be submitted to the Administrator within six months prior to (date two years after promulgation of these amendments). The request is to include:

(1) The reasons the source is incapable of being in compliance with the 5 ppm emission limit and data to support those reasons, and

(2) A suggested interim emission limit and description of the methodology for attaining that limit.

(b) Any owner or operator of a source who has submitted to the Administrator a written request for an interim emission limit in accordance with § 61.72(a), shall within 60 days of the date of the written request meet with the Administrator concerning the information contained in the request. The meeting is to be open to interested persons, who are to be allowed to submit oral or written testimony relevant to compliance of the source.

(c) The Administrator will within 120 days of receipt of the written request required by paragraph (a) of this section, notify the owner or operator in writing of approval or denial of approval of an interim emission limit.

(d) If an interim emission limit is approved the notification is to include the level of the interim emission limit, which may be the level requested or a more stringent one.

(e) A determination to deny approval of an interim emission limit is to set forth the specific grounds on which such denial is based.

(f) Approval for any interim emission limit granted for any source under § 61.72(c) shall expire three years from the date of issuance. The owner or operator may request an extension of approval for an interim emission limit or a lower interim emission limit. The request is to be in writing, is to be submitted within six months prior to a year before the expiration date and is to include the information listed in § 61.72 (b), (c), (d), and (e) are to apply.

9. A new § 61.73 is added to read as follows:

§ 61.73 Offset of emissions due to new construction.

(a) No owner or operator is to construct a new source which alone or in combination with other sources being constructed at the same time results in an increased production rate unless he demonstrates to the Administrator's satisfaction that such construction will not cause an increase in vinyl chloride emissions within 8 km of any other source which is subject to this subpart.

(b) Reduction in production rate is an allowable mechanism for attaining an offset in emissions.

(c) The baseline emission rate is to be determined based on the level of emissions allowable by the standard.

(d) Reducing emissions from an interim emission limit to the standard for a source is not an acceptable means of achieving an emission offset.

(e) In the application for approval of construction required by § 61.07, owners or operators of sources subject to this subpart shall include, in addition to the information required by § 61.07, the following information:

(1) The name, address, and location of any plant subject to this subpart which is located within 8 km of the proposed location of the source to be constructed.

(f) The emission limits applicable to both the new source(s) and the source(s) at which emissions are being reduced to balance the increase in emissions due to the new construction are to be established by the Administrator in the approval for construction required by § 61.08.

(Secs. 112 and 301(a) of the Clean Air Act, sec. 4(a) of Pub. L. No. 91-604, 84 Stat. 1683; sec. 2 of Pub. L. No. 90-148, 81 Stat. 504 (42 U.S.C. 1855c-7, 1857g(a)). Secs. 61.67 and 61.68 also issued under sec. 114 of the Clean Air Act, sec 4(a) of Pub. L. No. 91-604, 84 Stat. 1687 (42 U.S.C. 1857c-9).)

[FR Doc.77-15572 Filed 6-1-77;8:45 am]

SUMMARY TABLES OF MONITORING INFORM

Table #	Subject
1	NSPS Cource Categories Require to Continuously Monitor
2	Operational Monitoring Require
3	Emission Limitations
4	Proposal and Promulgation Date NSPS Source Categories
5	NSPS Continuous Monitoring Requirements
6	Quarterly Reporting Requiremen
7	Definitions of Excess Emission
8	Spanning and Zeroing
9	Span Specifications
10	Notifications Requirements
11	Specification Requirements
12	Performance Specifications
13	When to Run Monitor Performanc
14	Requirements for SIP Revision
15	Existing Sources Required to Continuously Monitor Emission
16	NESHAP Monitoring Requirement for Vinyl Chloride Sources

Table #1
NSPS SOURCE CATEGORIES REQUIRED TO CONTINUOUSLY MONITOR

SUBPART	SOURCE CATEGORY	CONTINUOUS MONITORING REQUIREMENTS	
		POLLUTANT (section)	PROCESS (section)
D	STEAM GENERATORS		
	Solid fossil fuel or solid fossil fuel and wood residue	opacity (60.45a) SO_2 (60.45b) NO_x (60.45c)	O_2 or CO_2 (60.45d)
	Liquid fossil fuel or liquid fossil fuel and wood residue	opacity (60.45a) SO_2 (60.45b) NO_x (60.45c)	O_2 or CO_2 (60.45d)
	Gaseous fossil fuel or gaseous fossil fuel and wood residue	NO_x (60.45c)	O_2 or CO_2 (60.45d)
	Combination of fossil fuels or combinations of fossil fuels and wood residue	opacity (60.45a) SO_2 (60.45b) NO_x (60.45c)	O_2 or CO_2 (60.45d)
G	NITRIC ACID PLANTS	NO_x (60.73a)	
H	SULFURIC ACID PLANTS	SO_2 (60.84a)	
J	PETROLEUM REFINERIES	opacity (60.105a) SO_2 or H_2S (60.105a)	
P	PRIMARY COPPER SMELTERS	opacity (60.165a) SO_2 (60.165b)	
Q	PRIMARY ZINC SMELTERS	opacity (60.175a) SO_2 (60.175a)	
R	PRIMARY LEAD SMELTERS	opacity (60.185a) SO_2 (60.185a)	
T,U,V,W,X	PHOSPHATE FERTILIZER PLANTS		Total pressure dro across process scrubbing system
T	Wet process phosphoric acid		(60.203c)
U	Superphosphoric acid		(60.213c)
V	Diammonium phosphate		(60.223c)
W	Triple superphosphate		(60.233c)
X	Granular triple superphosphate		(60.243c)
Y	COAL PREPARATION PLANTS		exit gas temperatu (60.253a) pressure loss through venturi (60.253a) water supply pressure to control equipment (60.253a

Table #1, continued

SUBPART	SOURCE CATEGORY	CONTINUOUS MONITORING REQUIREMENTS POLLUTANT (section)	PROCESS (section)
Z	FERRORALLOY PRODUCTION FACILITIES	opacity (60.264a)	flowrate through hood (60.265c) furnace power input 60.265(b)
AA	STEEL PLANTS	opacity (60.273a)	volumetric flow rate through each separately ducted hood (60. 274b) pressure in the free space inside the electric arc furnace (60.274e)

Table # 2

OPERATIONAL MONITORING REQUIREMENTS (NSPS)

(Non-continuous)

Subpart	Requirement
E. Incinerators	Daily charging rates and hours of operation.
F. Portland Cement Plants	Daily production rates and kiln feed rates.
G. Nitric Acid Plants	Daily production rate and hours of operation.
H. Sulfuric Acid Plants	The conversion factor shall be determined, as a minimum, three times daily by measuring the concentration of sulfur dioxide entering the converter.
J. Petroleum Refineries	Record daily the average coke burn-off rate and hours of operation for any fluid catalytic cracking unit catalyst regenerator subject to the particulate or carbon monoxide standard.
K. Storage Vessels for Petroleum Liquids	Maintain a file of each type of petroleum liquid stored and the dates of storage. Show when storage vessel is empty. Determine and record the average monthly storage temperature and true vapor pressure of the petroleum liquid stored if : (1) the petroleum liquid, as stored, has a vapor pressure greater than 26 mm Hg but less than 78 mm and is stored in a storage vessel other than one equipped with a floating roof, a vapor recovery system or their equivalents; or (2) the petroleum liquid has a true vapor pressure, as stored, greater than 470 mm Hg and is stored in a storage vessel other than one equipped with a vapor recovery system or its equivalent.

Table #2 continued

Subpart	Requirement
O. Sewage Treatment Plants	Install, calibrate, maintain, and operate a flow measuring device which can be used to determine either the mass or volume of sludge charged to the incinerator.
P. Primary Copper Smelter	Keep a monthly record of the total smelter charge and the weight percent (dry basis) of arsenic, antimony, lead, and zinc contained in this charge.
S. Primary Aluminum Reduction Plants	Determine daily, the weight of aluminum and anode produced. Maintain a record of daily production rates of aluminum and anodes, raw material feed rates, and cell or potline voltages.
T. Phosphate Fertilizer Industry: Wet-Process Phosphoric Acid Plants	Determine the mass flow of phosphorus-bearing feed material to the process. Maintain a daily record of equivalent P_2O_5 feed.
U. Phosphate Fertilizer Industry: Superphosphoric Acid Plants	Determine the mass flow of phosphorus-bearing feed material to the process. Record daily the equivalent P_2O_5 feed.
V. Phosphate Fertilizer Industry: Diammonium Phosphate Plants	Determine the mass flow of phosphorus-bearing feed material to the process. Maintain a daily record of equivalent P_2O_5 feed.
W. Phosphate Fertilizer Industry: Triple Superphosphate Plants	Determine the mass flow of phosphorus-bearing feed material to the process. Maintain a daily record of equivalent P_2O_5 feed.
X. Phosphate Fertilizer Industry	Maintain an accurate account of triple superphosphate in storage. Maintain a daily record of total equivalent P_2O_5 stored.

Table #2 continued

Subpart	Requirement
Z. Ferroalloy Production Facilities	Maintain daily records of (1) the product; (2) description of constituents of furnace charge, including the quantity, by weight; (3) the time and duration of each tapping period and the identification of material tapped (slag or product) (4) all furnace power input data; and (5) all flow rate data or all fan motor power consumption and pressure drop data.
AA. Steel Plants: Electric Arc Furnaces	Maintain daily records of (1) the time and duration of each charge; (2) the time and duration of each tap; (3) all flow rate data, and (4) all pressure data.

Table # 3

EMISSION LIMITATIONS (NSPS)

SUBPART	POLLUTANT	EMISSION LEVELS
D Fossil Fuel-Fired Steam Generators		
Liquid fossil fuel	Particulate	43 ng/joule (0.10 lb/10^6 BTU)
	Opacity	20%, 40% 2 min/hr
	SO_2	340 ng/joule (0.80 lb/10^6 BTU)
	NO_x	130 ng/joule (0.30 lb/10^6 BTU)
Solid fossil fuel	Particulate	43 ng/joule (0.10 lb/10^6 BTU)
	Opacity	20%, 40% 2 min/hr
	SO_2	520 ng/joule (1.2 lb/10^6 BTU)
	NO_x	300 ng/joule (0.70 lb/10^6 BTU)
Gaseous fossil fuel	Particulate	43 ng/joule (0.10 lb/10^6 BTU)
	Opacity	20%, 40% 2 min/hr
	NO_x	86 ng/joule (0.20 lb/10^6 BTU)
Mixture of fossil fuel	Particulate	43 ng/joule (0.10 lb/10^6 BTU)
	Opacity	20%, 40% 2 min/hr
	SO_2	$\frac{y(340) + z(520)}{y + z}$ *
	NO_x	$\frac{x(86) + y(130) + z(300)}{x + y + z}$

*x = percentage of total heat input from gaseous fossil fuel
y = percentage of total heat input from liquid fossil fuel
z = percentage of total heat input from solid fossil fuel

Table #3, continued

SUBPART	POLLUTANT	EMISSION LEVELS
E Incinerators	Particulate	0.18 g/dscm (0.08 gr/dscf) (corrected to 12% CO_2)
F Portland Cement Plants		
Kiln	Particulate	0.15 kg/metric ton (0.30 lb/ton)
	Opacity	10%
Clinker cooler	Particulate	0.05 kg/metric ton of feed (0.10 lb/ton)
	Opacity	20%
Other emission points	Opacity	10%
G Nitric Acid Plants	NO_2	1.5 kg/metric tons of acid produced (3.0 lb/ton of acid produced)
	Opacity	10%
H Sulfuric Acid Plants	SO_2	2 kg/metric tons of acid produced (4.0 lb/ton of acid produced)
	H_2SO_4 mist	0.075 kg/metric tons of acid produced (0.15 lb/ton)
I Asphalt Concrete Plants	Particulate	90 mg/dscm (0.04 gr/dscf)
	Opacity	20%
J Petroleum Refineries		
Catalytic cracker	Particulate	1.0 kg/1000kg of coke burn-off (1.0 lb/1000 lb)
	Opacity	30% (3 min/hr exemption)

Table # 3, continued

SUBPART	POLLUTANT	EMISSION LEVELS
	CO	0.05%
K Storage Vessels for Petroleum Liquids	Hydrocarbons	If vapor pressure is 78-570 mm Hg the storage vessel shall be equipped with a floating roof or a vapor recovery system or thin equivalents. If vapor pressure is greater than 570 mm Hg, the storage vessel shall be equipped with a vapor recovery system
L Secondary Lead Smelters		
Reverberatory and blast furnaces	Particulate	50 mg/dscm (0.022 gr/dscf)
	Opacity	20%
Pot furnaces	Opacity	10%
M Secondary Brass and Bronze Plants		
Reverberatory furnaces	Particulate	50 mg/dscm (0.022 gr/dscf)
	Opacity	20%
Blast and electric furnaces	Opacity	10%
N Iron and Steel Plants	Particulate	50 mg/dscm (0.022 gr/dscf)
O Sewage Treatment Plants	Particulate	0.65 g/kg dry sludge input (1.30 lb/ton)
	Opacity	20%
P Primary Copper Smelters		
Dryer	Particulate	50 mg/dscm (0.022 gr/dscf)

Table # 3, continued

SUBPART	POLLUTANT	EMISSION LEVELS
	Opacity	20%
Roaster, smelting furnace, copper converter	SO_2	0.065%
	Opacity	20%
Q Primary Zinc Smelters		
Sintering machine	Particulate	50 mg/dscm (0.022 gr/dscf)
	Opacity	20%
Roaster	SO_2	0.065%
	Opacity	20%
R Primary Lead Smelters		
Blast or reverberatory furnace, sintering machine discharge end	Particulate	50 mg/dscm (0.022 gr/dscf)
	Opacity	20%
Sintering machine, electric smelting furnace, converter	SO_2	0.065%
	Opacity	20%
S Primary Aluminum Reduction Plants		
Soderberg plants	Total fluorides	1 kg/metric ton of Al produced (2 lb/ton)
	Opacity	10%
Prebake plants	Total fluorides	0.95 kg/metric ton of Al produced (1.9 lb/ton)
	Opacity	10%
Anode bake plants	Total fluorides	0.05 kg/metric ton of Al produced
	Opacity	20%

Table # 3, continued

SUBPART		POLLUTANT	EMISSION LEVELS
T	Phosphate Fertilizer Industry: Wet Process Phosphoric Acid Plants	Total fluorides	10 g/metric ton of P_2O_5 feed (0.020 lb/ton)
U	Phosphate Fertilizer Industry: Super-phosphoric Acid Plants	Total fluorides	5 g/metric ton of P_2O_5 feed (0.020 lb/ton)
V	Phosphate Fertilizer Industry: Diammonium Phosphate	Total fluorides	30 g/metric ton of P_2O_5 feed (0.060 lb/ton)
W	Phosphate Fertilizer Industry: Triple Super-Phosphate	Total fluorides	100 g/metric ton of equivalent P_2O_5 feed (0.20 lb/ton)
X	Phosphate Fertilizer Industry: Granular Triple Superphosphate	Total fluorides	0.25 g/hr/metric ton of equivalent P_2O_5 stored (5.0 x 10^{-4} lb/hr/ton)
Y	Coal Preparation Plants		
	Thermal dryer	Particulate	0.070 g/dscm (0.031 gr/dscf)
		Opacity	20%
	Pneumatic coal cleaving equipment	Particulate	0.040 g/dscm (0.031 gr/dscf)
		Opacity	10%
	Processing and conveying equipment, storage systems, transfer and loading systems	Opacity	20%

Table # 3, continued

SUBPART	POLLUTANT	EMISSION LEVELS
Z Ferroalloy Production Facilities		
Electric submerged arc furnaces	Particulate	0.45 kg/MW-hr (0.99 lb/MW-hr) (high silicon alloys) 0.23 kg/MW-hr (0.51 lb/MW-hr) (chrome and manganese alloys)
	Opacity	15%
	CO	20%
Dust handling equipment	Opacity	10%
AA Steel Plants		
Electric arc furnaces	Particulate	12 mg/dscm (0.0052 gr/dscf)
Control device	Opacity	3%
Shop roof	Opacity	0, except: 20% - charging 40% - tapping
Dust handling equipment	Opacity	10%

Table # 4

PROPOSAL AND PROMULGATION DATES FOR NSPS SOURCE CATEGORIES

Subpart	Source	Promulgation Date	Proposed Date
D	Fossil Fuel Fired Steam Generators	12/23/71	8/17/71
E	Incinerators	12/23/71	8/17/71
F	Portland Cement Plants	12/23/71	8/17/71
G	Nitric Acid Plants	12/23/71	8/17/71
H	Sulfuric Acid Plants	12/23/71	8/17/71
I	Asphalt Concrete Plants	3/8/74	6/11/73
J	Petroleum Refineries	3/8/74	6/11/73
K	Storage Vessels for Petroleum Liquids	3/8/74	6/11/73
L	Secondary Lead Smelters	3/8/74	6/11/73
M	Brass and Bronze Production Plants	3/8/74	6/11/73
N	Iron and Steel Plants	3/8/74	6/11/73
O	Sewage Treatment Plants	3/8/74	6/11/73
P	Primary Copper Smelter	1/15/76	10/16/74
Q	Primary Zinc Smelter	1/15/76	10/16/74
R	Primary Lead Smelter	1/15/76	10/16/74
S	Primary Aluminum Reduction Plants	1/26/76	10/23/74
TUVWX	Phosphate Fertilizer Industry	8/6/75	10/22/74
	Coal Preparation Plants	1/15/76	10/24/74
Z	Ferroalloy Production Facilities	5/4/76	10/21/74
AA	Steel Plants: Electric Arc Furnaces	9/23/75	10/21/74

Table #5
CONTINUOUS MONITORING REQUIREMENTS

I. Installed and operational prior to conducting performance tests[1]

II. Conduct monitoring system performance evaluations during performance tests or 30 days thereafter (for specification requirements, see Table #11)

III. Check zero and span drift at least daily (see Table #8)

IV. Time for cycle of operations (sampling, analyzing, and data recording)
    A. Opacity - 10 seconds
    B. Gas Monitors - 15 minutes

V. Installed to provide representative sampling

VI. Reduction of data
    A. Opacity - 6-minute average
    B. Gaseous Pollutants - hourly average

VII. Source must notify agency, more than 30 days prior, of date upon which demonstration of continuous monitoring system performance is to commence.

---

[1] Performance tests shall be conducted within 60 days after achieving the maximum production rate at which the affected facility will be operated, but not later than 180 days after initial startup of such facility.

Table #6
QUARTERLY REPORTING REQUIREMENTS[1] (NSPS)

I. Excess Emissions
  A. Description of Excess Emission
    1. Magnitude
    2. Conversion factors used
    3. Date and time of commencement and completion
  B. Explanation of Excess Emission
    1. Occurrances during startups, shutdowns, and malfunctions
    2. Nature and cause of malfunction
    3. Corrective and preventative action taken
  C. To be Submitted in Units Same as Standard

II. Continuous Monitoring Systems
  A. Date and Time when System was Inoperative (except for zero and span checks)
  B. Nature of System Repairs or Adjustments

III. Lack of Occurrances During A Quarter
  A. Absence of Excess Emissions during Quarter
  B. Absence of Adjustments, Repairs, or Inoperativeness of Continuous Monitoring System

---

[1] "Each owner or operator required to install a continuous monitoring system shall submit a written report ... for every calendar quarter"

"All quarterly reports shall be postmarked by the 30th day following the end of each calendar quarter..."

Table #7

DEFINITION OF EXCESS EMISSIONS (NSPS)

SUBPART	POLLUTANT	EXCESS EMISSION
D	opacity	any six-minute period during which the average opacity of emissions exceeds 20% opacity, except that one six-minute average per hour of up to 27% opacity need not be reported.
	SO_2	any three-hour period during which the average emissions of SO_2 (arithmetic average of three contiguous one-hour periods) exceed the standard
	NO_x	any three-hour period during which the average emissions of NO_x (arithmetic average of three contiguous one-hour periods) exceed the standard
G	NO_x	any three-hour period during which the average nitrogen oxides emissions (arithmetic average of three contiguous one-hour periods) exceed the standard
H	SO_2	all three hour periods (or the arithmetic average of three consecutive one hour periods) during which the integrated average sulfur dioxide emissions exceed the applicable standards
J	Opacity	all one-hour periods which contain two or more six-minute periods during which the average opacity exceeds 30 percent.
	SO_2	any six-hour period during which the average emissions of SO_2 (arithmetic average of six contiguous one-hour periods) exceed the standard
P	Opacity	any six-minute period during which the average opacity exceeds the standard
	SO_2	any six-hour period during which the average emissions of SO_2 (arithmetic mean of six contiguous one-hour periods) exceed the standard
Q	Opacity	any six minute period during which the average opacity exceeds the standard
	SO_2	any two hour period during which the average emissions of SO_2 (arithmetic mean of two contiguous one-hour periods) exceed the standard

Table #. 7, continued

SUBPART	POLLUTANT	EXCESS EMISSION
R	Opacity	any six minute period during which the average opacity exceeds the standard
	SO_2	any two hour period during which the average emissions of SO_2 (arithmetic mean of two contiguous one hour periods) exceed the standard
Z	Opacity	all six minute periods in which the average opacity is 15 percent or greater
AA	Opacity	all six minute periods during which the average opactiy is 3 percent or greater

Table #8

SPANNING AND ZEROING

- I. **Explanation of Zero and Span Checks**
  - A. Extractive gas monitors
    - 1. Span gas composition
      - a. SO_2 - sulfur dioxide/nitrogen or gas mixture
      - b. NO - nitric oxide/oxygen-free nitrogen mixture
      - c. NO_2 - nitrogen dioxide/air mixture
    - 2. Zero gases
      - a. Ambient air
      - or b. A gas certified by the manufacturer to contain less than 1 ppm of the pollutant gas
    - 3. Analysis of span and zero gases
      - a. Span and zero gases certified by their manufacturer to be traceable to National Bureau of Standards reference gases shall be used whenever these gases are available
      - b. Span and zero gases should be reanalyzed every six months after date of manufacture with Reference Method 6 for SO_2 and 7 for NO_x
      - c. Span and zero gases shall be analyzed two weeks prior to performance specification tests
  - B. Non-extractive gas monitors
    - 1. Span check - certified gas cell or test cell
    - 2. Zero check - mechanically produced or calculated from upscale measurements
  - C. Transmissometers
    - 1. Span check is a neutral density filter that is certified within ± 3 percent opacity
    - 2. Zero check is a simulated zero
  - D. Span values are specified in each subpart (see table #10)
    - 1. Span check is 90% of span.

- II. Adjustment of Span and Zero
  - A. Adjust the zero and span whenever the zero or calibration drift exceeds the limits of applicable performance specification in Appendix B.
    - 1. For opacity, clean optical surfaces before adjusting zero or span drift
    - 2. For opacity systems using automatic zero adjustments, the optical surfaces shall be cleaned when the cumulative automatic zero compensation exceeds four percent opacity

- III. How to Span and Zero
  - A. Extractive gas monitors
    - 1. Introduce the zero and span gas into the monitoring system as near the probe as practical
  - B. Non-extractive gas monitors
    - 1. Use a certified gas cell or test cell to check span
    - 2. The zero check is performed by computing the zero value from upscale measurements or by mechanically producing a zero
  - C. Transmissometers
    - 1. Span check with a neutral density filter
    - 2. Zero check by simulating a zero opacity

Table # 9
SPAN SPECIFICATIONS

SUBPART		POLLUTANT	SPAN
D	Fossil Fuel Fired Steam Generators		
	liquid fossil fuel	opacity SO_2 NO_x	80, 90, or 100% opacity 1000 ppm 500 ppm
	solid fossil fuel	opacity SO_2 NO_x	80, 90, or 100% opacity 1500 ppm 1000
	gaseous fuel	NO_x	500 ppm
	mixtures of fossil fuels	opacity SO_2 NO_x	80,90, or 100% opacity 1000y + 1500z [1] 500 (x+y) + 1000z
G	Nitric Acid Plants	NO_2	500 ppm
H	Sulfuric Acid Plants	SO_2	1000 ppm
J	Petroleum Refineries	Opacity SO_2	60,70, or 80% opacity 100 ppm
P	Primary Copper Smelters	Opacity SO_2	80 to 100% opacity 0.20% by volume
Q	Primary Zinc Smelters	Opacity	80 to 100% opacity 0.20% by volume
R	Primary Lead Smelters	Opacity SO_2	80 to 100% opacity 0.20% by volume
Z	Ferroalloy Production Facilities	Opacity	not specified
AA	Steel Plants	Opacity	not specified

[1]
x = fraction of total heat input from gas

y = fraction of total heat input from liquid fossil fuel

z = fraction of total heat input from solid fossil fuel

Span value shall be rounded off to the nearest 500 ppm

Table #10
NOTIFICATION REQUIREMENTS [1] (NSPS)

	Requirements	Time Deadline
I.	Date of Commencement of Construction	Less than 30 days after such date
II.	Anticipated Date of Initial Startup	Less than 60 or more than 30 days prior to date
III.	Actual Date of Initial Startup	Within 15 days after date
IV.	Any physical or operational change to a facility which may increase the emission rate of any air pollutant to which a standard applies A. The precise nature of the change B. Present and proposed emission control systems C. Productive capacity before and after the change D. Expected completion date of change	Postmarked 60 days or as soon as practical before the change is commenced
V.	Date upon which demonstration of continuous monitoring system performance commences	more than 30 days prior

---

[1] "Any owner or operator subject to the provisions of this part shall furnish the Administrator written notification..."

Table #11

SPECIFICATION REQUIREMENTS (NSPS)

	Sept. 11, 1974		October 6, 1975	
	Before	After Before	After	Specification Requirements
CASE 1*	PI			None-unless requested by the administrator
CASE 2*	P	I		None-unless requested by the administrator
CASE 3*	P		I	Accuracy
CASE 4		PI		All requirements in Appendix B
CASE 5		P	I	All requirements in Appendix B
CASE 6			PI	All requirements in Appendix B

P - Purchased

I - Installed

* Cases 1,2, and 3 shall be upgraded or replaced with new continuous monitoring systems and shall comply with Specification Requirements in Appendix B by September 11, 1979

Table #12

PERFORMANCE SPECIFICATIONS

TRANSMISSOMETERS

Calibration error	$\leq$ 3 pct opacity
Zero drift (24h)	$\leq$ 2 pct opacity
Calibration drift (24h)	$\leq$ 2 pct opacity
Response time	10 s maximum
Operational test period	168 hours

NO_x and SO_2

Accuracy	$\leq$20 pct of the mean value of the reference method test dat
Calibration error	$\leq$5 pct of (50 pct, 90 pct) calibration gas mixture value
Zero drift (2h)	2 pct of span
Zero drift (24h)	2 pct of span
Calibration drift (2h)	2 pct of span
Calibration drift (24h)	2.5 pct of span
Response time	15 min maximum
Operational period	168 h minimum

O_2 and CO_2

Zero drift (2h)	$\leq$0.4 pct O_2 or CO_2
Zero drift (24h)	$\leq$0.5 pct O_2 or CO_2
Calibration drift (2h)	$\leq$0.4 pct O_2 or CO_2
Operational period	168 H minimum
Response time	10 min

TABLE #13

WHEN TO RUN THE MONITOR PERFORMANCE TEST

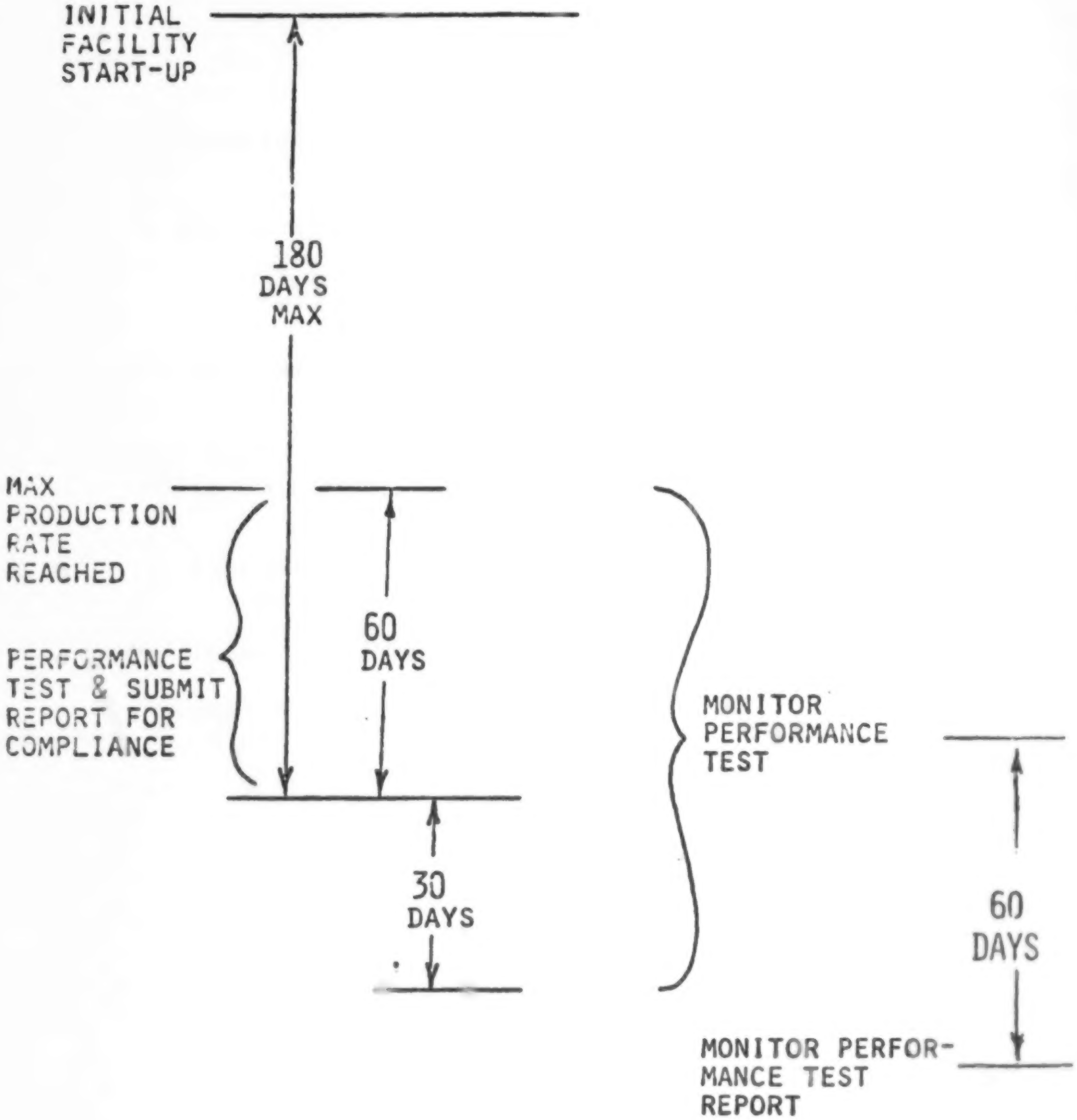

INITIAL FACILITY START-UP
180 DAYS MAX
MAX PRODUCTION RATE REACHED
PERFORMANCE TEST & SUBMIT REPORT FOR COMPLIANCE
60 DAYS
30 DAYS
MONITOR PERFORMANCE TEST
60 DAYS
MONITOR PERFORMANCE TEST REPORT

Table #14

REQUIREMENTS FOR SIP REVISIONS

I. Submit SIP Revisions by October 6, 1976

II. Contain monitoring requirements for the following sources (as a minimum)

   A. Fossil Fuel-Fired Steam Generators
   B. Sulfuric Acid Plants
   C. Nitric Acid Plants
   D. Petroleum Refineries
   (see Table #15)

III. Require that sources evaluate the performance of their monitoring system

IV. Require the sources to maintain a file of all pertinent continuous monitoring data

   A. Emission measurements
   B. Monitoring system evaluation data
   C. Adjustments and maintenance performed on the monitoring system

V. Require the source to submit periodic (such period not to exceed 3 months) reports containing the following information.

   A. Number and magnitude of excess emissions
   B. Nature and cause of excess emissions
   C. Statement concerning absence of excess emissions and/or monitor inoperativeness

VI. Require that monitoring begin within 18 months of EPA approval of the SIP revision (or within 18 months of EPA promulgation)

TABLE #15

EXISTING SOURCES REQUIRED TO CONTINUOUSLY MONITOR EMISSIONS

Source	Pollutant	Comments
Fossil Fuel-Fired Steam Generators	SO_2	1. >250 x 10^6 Btu/hr 2. Source that has control equipment for SO_2
	NO_x	1. >1000 x 10^6 Btu/hr 2. Located in a designated non-attainment area for NO_2. 3. Exempt if source is 30% or more below the emission standard
	Opacity	1. >250 x 10^6 Btu/hr 2. Exempt if burning gas 3. Exempt if burning oil, or a mixture of oil and gas are the only fuels used and the source is able to comply with the applicable particulate matter and opacity standards without installation of control equipment
Nitric Acid Plants	NO_x	1. >300 ton/day 2. Located in a designated non-attainment area for NO_2.
Sulfuric Acid Plants	SO_2	1. >300 tons/day
Petroleum Refineries	Opacity	1. >20,000 barrels/day

Table # 16

NESHAP MONITORING REQUIREMENTS
FOR VINYL CHLORIDE SOURCES

I EDC PLANTS

- A. All exhaust gases discharged from any equipment used in EDC purification.
- B. Emissions from each oxychlorination reactor

II VC PLANTS

- A. All exhaust gases discharged from any equipment used in vinyl chloride formation.

III PVC PLANTS

- A. All exhaust gases discharged from each reactor.
- B. All exhaust gases discharged from each stripper.
- C. All exhaust gases discharged from each mixing, weighing or holding container which precedes the stripper (or reactor if plant has no stripper).
- D. All exhaust gases discharged from each monomer recovery system.

IV EDC, VC AND PVC PLANTS - ANY CONTROL SYSTEM TO WHICH REACTOR EMISSIONS ARE REQUIRED TO BE DUCTED FROM

- A. Loading or unloading lines
- B. Slip gauges
- C. Manually vented equipment
- D. Equipment opened to the atmosphere from which vinyl chloride is removed prior to opening
- E. Inprocess wastewater

VENDORS OF CONTINUOUS MONITORING EQUIPMENT

Page No.

1. Vendors IV-1

2. Addresses IV-4

VENDORS OF CONTINUOUS MONITORING EQUIPMENT

VENDOR	SO_2	NO_x	Opacity	O_2	CO_2	TRS	H_2S	Data Handling Equipment
Acurex Corporation, Autodata Division	x	x	x	x	x			
Adam David Company				x				
Air Resources, Inc.								x
Alden Electronic and Impulse Recording								x
Applied Dynamics								x
Babcock and Wilcox Company, Bailey Meter Co.	x		x	x	x	x		
Ball Brothers Research Corporation								x
Beckman Instruments, Inc. Process Inst. Div.	x	x		x	x			x
Becton Dickinson and Company				x				
Bell and Howell Company								x
The Bendix Corporation, Env. Science Division								x
The Bendix Corporation, Process Instruments Div.								x
BIF, A Unit of General Signal								x
BioMarine Industries, Inc.				x				
The Bristol Company								x
Campbell Scientific								x
Calibrated Instruments, Inc.	x							
Cambridge Instrument Company				x				
CEA Instruments	x	x					x	
Cleveland Controls, Inc.	x		x	x				
Climatronics Corporation								x
Climet Instruments								x
Contraves-Goerz Corporation	x		x		x			
Curtis Instruments, Inc.								x
De-Tec-Tronic Corporation			x					
Digilab, Inc.	x	x		x	x		x	
E. I. Du Pont de Nemours and Company	x	x		x	x	x	x	
Dynatron, Inc.			x	x				
Ecologic Instrument Corporation								x
Ecology Board, Inc.	x	x		x			x	
Electronics Corporation of American			x					
Energetics Science, Inc.		x					x	
Environmental Data Corporation	x	x	x	x	x		x	
Environmental Measurements, Inc.								x
Environmental Research and Technology	x	x			x		x	

VENDOR	SO_2	NO_x	Opacity	O_2	CO_2	TRS	H_2S	Data Handling Equipment
Esterline Angus								x
Ethyl Intertech Corporation	x	x	x	x	x		x	
Fisher and Porter Company								x
FluiDynamic Devices Ltd.								x
F & M Systems Company								x
FoldaRoll								x
The Foxboro Company								x
FX Systems Corporation								x
General Electric Company								x
General Monitors, Inc.				x			x	
Hewlett-Packard					x			
HNU Systems, Inc.						x	x	
Horiba Instruments, Inc.	x	x			x			
Houston Atlas, Inc.							x	
Ikor, Inc.								x
Infrared Industries					x			
Intertech Corporation								x
Jacoby-Tarbox Corporation			x					
KVB Equipment Corporation								x
Lazar Research Labs, Inc.	x				x		x	
Lear Siegler, Inc.	x	x	x	x				
Leeds and Northrup Company	x		x	x	x			x
Meloy Labroatories, Inc.	x	x					x	
Meteorology Research, Inc.	x	x	x	x				
Metrodata Systems, Inc.								x
Mine Safety Appliance Company	x	x		x	x		x	
Monitor Labs, Inc.	x	x					x	x
Motorola, Inc.								x
Photomation, Inc.			x					
Quindar Electronics, Inc.								x
Reliance Instrument Mfg. Company			x					
Research Appliance Company			x					x
RFL Industries, Inc.								x
Rockwell International								x

VENDOR	SO_2	NO_x	Opacity	O_2	CO_2	TRS	H_2S	Data Handling Equipment
Milton Roy Company				x	x			
Science Associates, Inc.								x
Source Gas Analyzers, Inc.		x						
Spatial Data Systems, Inc.								x
Sun Electric Corporation								x
Sybron Corporation				x				x
Teledyne, Inc. Analytical Instruments Division				x			x	
Teledyne Geotech								x
Texas Instruments, Inc.								x
Thermco Instrument Corporation				x				
Thermo Electron Corporation	x	x						x
Thermox Instruments, Inc.				x				
Tracor, Inc.	x					x	x	
Robert H. Wagoner Company, Inc.			x					
Weather Measure Corporation								x
Western Precipitation Division		x	x	x			x	
Western Research and Development Ltd.	x			x			x	x
Whittaker Corporation	x	x	x	x		x	x	
Wilks Scientific Corporation	x	x			x			
Xonics, Inc.								x

Acurex Corporation
Autodata Division
485 Clyde Avenue
Mountain View, Ca. 94042

Adam David Company
115 East Maple Avenue
Langhorne, Pa. 19047

Air Resources, Inc.
800 East Northwest Highway
Palatine, Ill. 60067

Alden Electronic & Impulse Recording
Equipment Company, Inc.
Washington Street
Westboro, Ma. 01581

Applied Dynamics
Post Office Box 1488
Ann Arbor, Michigan 48106

Babcock & Wilcox, Company
Bailey Meter Company
29801 Euclid Avenue
Wickliffe, Oh. 44092

Ball Brothers Research Corp.
Environmental Systems Group
Post Office Box 1062
Boulder, Colo. 80302

Beckman Instruments, Inc.
Process Instruments Division
2500 Harbor Blvd.
Fullerton, Ca. 92634

Becton Dickinson & Co.
Edmont-Wilson Division
3089 Walnut Street
Coshocton, Oh. 43812

Bell and Howell Company
Electronics and Instruments Group
360 Sierra Madre Villa
Pasadena, Ca. 91109

The Bendix Corp., Env. Science Div.
1400 Taylor Avenue
Baltimore, Maryland 21204

The Bendix Corp., Process Inst. Div.
Post Office Drawer 831
Lewisburg, W. Va. 24901

BIF, A Unit of General Signal
345 Harris Avenue
Providence, R. I. 02901

BioMarine Industries, Inc.
45 Great Valley Ctr.
Malvern, Pa. 19355

The Bristol Company
Waterbury, Ct. 06720

Campbell Scientific
Post Office Box 551
Logan, Utah 84321

Calibrated Instruments, Inc.
731 Saw Mill River Rd.
Ardsley, N. Y. 10502

Cambridge Instrument Co.
73 Spring Street
Ossining, N. Y. 10562

CEA Instruments
Div. of CEA Combustion, Inc.
61 Taylor Reed Place
Stamford, Ct. 06906

Cleveland Controls, Inc.
1111 Brookpark Rd.
Cleveland, Oh. 44109

Climatronics Corporation
1324 Motor Parkway
Hauppage, N. Y. 11787

Climet Instruments
Division of Wehr Corporation
1620 West Colton Avenue
Redland, Ca. 92373

Contraves-Goerz Corporation
301 Alpha Drive
Pittsburgh, Pa. 15238

Curtis Instruments, Inc.
200 Kisco Avenue
Mount Kisco, New York 10549

De-Tec-Tronic Corporation
2512 North Halsted Street
Chicago, Illinois 60614

Digilab, Inc.
237 Putnam Avenue
Cambridge, Ma. 02139

E. I. Du Pont de Nemours and Company
1007 Market Street
Wilmington, Del. 19898

Dynatron, Inc.
Energy Conservation Systems
57 State Street
North Haven, Ct. 06473

Ecologic Instrument Corporation
587 Old Willets Path
Hauppauge, N. Y. 11789

Ecology Board, Inc.
9257 Independence Avenue
Chatsworth, Ca. 91311

Electronics Corporation of America
1 Memorial Drive
Cambridge, Mass. 02142

Energetics Science, Inc.
85 Executive Blvd.
Elmsford, N. Y. 10523

Environmental Data Corporation
608 Fig Avenue
Monrovia, California 91016

Environmental Measurements, Inc.
215 Leidesdorff Street
San Francisco, Ca. 94111

Environmental Research & Technology, Inc.
696 Virginia Road
Concord, Ma. 01742

Esterline Angus
A Unit of Esterline Corporation
Post Office Box 24000
Indianapolis, Indiana 46224

Ethyl Intertech Corporation
Sub. of Ethyl Corporation
19 Roszel Road
Princeton, N. J. 08540

Fisher & Porter Company
Warminster Road
Warminster, Pa. 19874

FluiDynamic Devices, Ltd.
3216 Lenworth Drive
Mississauga, Ontario
Canada

F & M Systems Company
2525 Walnut Hill Lane
Post Office Box 20778
Dallas, Texas 75220

FoldaRoll Company
Post Office Box 24121
Los Angeles, California 90024

The Foxboro Company
38 Niponset Avenue
Foxboro, Ma. 07039

FX Systems Corporation
P.O. Box 818, 77 Cornell Street
Kingston, N. Y. 12401

General Electric Co., Re-entry & Env. Sys. Div.
3198 Chestnut Street
Philadelphia, Pa. 19101

General Monitors, Inc.
3019 Enterprise Street
Cost Mesa, Ca. 92626

Hewlett-Packard, Avondale Division
Route 41 and Starr Road
Avondale, Pa. 19311

HNU Systems, Inc.
383 Elliot Street
Newton Upper Falls, Ma. 02164

Horiba Instrument, Inc.
1021 Durgea Avenue
Irvine, Ca. 92714

Houston Atlas, Inc.
10216 Geogibelle
Houston, Texas 77043

Ikor, Inc.
217 Middlesex Turnpike
Burlington, Mass. 01803

Infrared Industries, Western Division
Post Office Box 989
Santa Barbara, Ca. 93102

Intertech Corporation
Subsidiary of Ethyl Corporation
19 Roszel Road
Princeton, New Jersey 08540

Jacoby-Tarbox Corporation
808 Nepperham Avenue
Yonkers, New York 10703

KVB Equipment Corporation
17332 Irvine Blvd.
Tustin, Ca. 92680

Lazar Research Labs, Inc.
509 North Fairfax Avenue
Los Angeles, Ca. 90036

Lear Siegler, Inc.
Environmental Technology Division
74 Inverness Drive, East
Englewood, Co. 80110

Leeds and Northrup Company
Sumneytown Pike
North Wales, Pa. 19454

Meloy Laboratores, Inc.
Instrument and Systems Division
6715 Electronic Drive
North Springfield, Va. 22157

Meteorology Research, Inc.
Theta Sensors, Inc.
Box 637
Altadena, Ca. 91001

Metrodata Systems, Inc.
Post Office Box 1307
Norman, Okla. 73069

Mine Safety Appliance Company
400 Penn Center
Pittsburgh, Pa. 15235

Monitor Labs, Inc.
4202 Sorrento Valley Blvd.
San Diego, Ca. 92121

Motorola, Inc.
1120 Connecticut Avenue, NW
Suite 1120
Washington, D. C. 20036

Photomation, Inc.
270 Polaris Avenue
Mt. View, Ca. 94041

Quindar Electronics, Inc.
60 Fadem Road
Springfield, N. J. 07081

Reliance Instrument Mfg. Company
164 Garibaldi Avenue
Lodi, N. J. 07644

Research Appliance Company, Chemed Corp.
Route 8
Gibsonia, Pa. 15044

RFL Industries, Inc.
Boonton, New Jersey 07005

Rockwell International, Air Monitoring Center
242 A Hillcrest Drive
Newbury Park, Ca. 91320

Milton Roy Company
Hays-Republic Division
4333 South Ohio Street
Michigan City, Ind. 46360

Science Associates, Inc.
230 Nassau Street
Box 230
Princeton, N. J. 08540

Source Gas Analyzers, Inc.
7251 Garden Grove Blvd.
Garden Grove, Ca. 92641

Spatial Data Systems, Inc.
132 Aero Camino
Goleta, Ca. 93017

Sun Electric Corp.
6323 Avondale Avenue
Chicago, Ill. 60631

Sybron Corporation
Taylor Instr. Proc. Contr. Division
95 Ames Street
Rochester, N. Y. 14601

Teledyne, Inc., Analytical Instrument Division
333 West Mission Drive
San Gabriel, Ca. 91776

Teledyne Geotech
3401 Shiloh Road
Garland, Texas 75041

Texas Instruments, Inc.
P. O. Box 5474, Mail Station 147
Dallas, Texas 75222

Thermco Instrument Corporation
Post Office Box 309
Laporte, In. 46350

Thermo Electron Corporation
85 First Avenue
Waltham, Ma. 02154

Thermox Instruments, Inc.
6592 Hamilton Avenue
Pittsburgh, Pa. 15206

Tracor, Inc.
Instruments Division
6500 Tracor Lane
Austin, Texas 78721

Robert H. Wagoner Company, Inc.
Passaic Avenue
Chatham, N. J. 07928

Weather Measure Corp.
3213 Orange Grove Ave.
North Highlands, Cal. 95660

Western Precipitation Division
Joy Manufacturing Co.
Post Office Box 2744 Terminal Annex
Los Angeles, Ca. 90051

Western Research and Development, Ltd.
1313 44th Avenue NE
Calgary, Alta

Whittaker Corporation
Environmental Production Division
9100 Independence Avenue
Chatsworth, Ca. 91311

Wilks Scientific Corporation
140 Water
Post Office Box 449
South Norwalk, Ct. 06856

Xonics, Inc.
6862 Hayvenhurst Avenue
Van Nuys, Ca. 91406

BIBLIOGRAPHY

Page No.

1. Bibliography Index V-1

2. Bibliography V-2

3. Availability of EPA Publications V-7

BIBLIOGRAPHY INDEX

Subject	Reference Numbers
Transmissometry	
Principles and application	1, 12, 13, 29, 33, 39
Instrumentation	8
Evaluation of methods	31
Used at Fossil Fuel-Fired Steam Generator	2
Used at Refinery	41
Gaseous Emission Monitoring	
Principles and application	7, 9, 10, 21, 23, 24, 47, 48, 49
Instrumentation	8, 26, 44
Evaluation of methods	3, 15, 20, 31, 36
Used at Copper Smelter Acid Plants	40, 42
Used at Sulfuric Acid Plants	43
Used at Fossil Fuel-Fired Steam Generators	2
Used at Steel Plants	46
Sampling handling	31, 32
References used for the establishment and support regulations	2, 34, 35, 38, 41, 42
Vendors	18, 27, 37
Regulations	45
General	4, 5, 6, 11, 14, 16, 19, 22, 25, 28, 20, 50

BIBLIOGRAPHY

1. Avetta, Edward D., IN-STACK TRANSMISSOMETER EVALUATION AND APPLICATION TO PARTICULATE OPACITY MEASUREMENT. EPA contract no. 68-02-0660 Owens, Illinois NTIS PB 242402 Jan. 1975.

2. Baladi, Emile Midwest Research Institute, MANUAL SOURCE TESTING AND CONTINUOUS MONITORING CALIBRATIONS AT THE LAWRENCE ENERGY CENTER OF KANSAS POWER AND LIGHT COMPANY, EPA contract no. 68-02-0228, EPA Report no. 73-SPP-3, May 7, 1976.

3. Barnes, H. B., C. R. Fortune, and J. B. Homolya, AN EVALUATION OF MEASUREMENT METHODOLOGY FOR THE CHARACTERIZATION OF GASEOUS SULFUR EMISSIONS FROM COMBUSTION SOURCES, Presented at the Fourth National Conference on Energy and the Environment Cincinnati, Ohio, October 4-7, 1976.

4. Blosser, R. O., A. G. Kutyna, R. A. Schmall, M. E. Franklin, and K. Jain. THE STATUS OF SOURCE EMISSION MONITORING AND MEASUREMENTS. Presented at the Technical Association of the Pulp and Paper Industry, Annual meeting Miami Beach, Florida, January, 1974.

5. Bonam, W. L. and W. F. Fuller, CERTIFICATION EXPERIENCE WITH EXTRACTIVE EMISSION MONITORING SYSTEMS, SRI-Proceeding of Workshop on Sampling, Analysis, and Monitoring of Stack Emissions, April, 1976, PB-252-748.

6. Brooks, E. F., GUIDELINES FOR STATIONARY SOURCE CONTINUOUS GAS MONITORING SYSTEMS, EPA Contract number 68-02-1412, TRN Systems Group, November, 1975.

7. Brooks, E. F., C. A. Flegal, L. N. Harnett, M. A. Kolpin, D. J. Luciani, and R. L. Williams CONTINUOUS MEASUREMENT OF GAS COMPOSITION FROM STATIONARY SOURCES, TRW Systems Group, EPA Contract no. 68-02-0636, EPA-600/2-75-012.

8. Chapman, Robert L., INSTRUMENTATION FOR STACK MONITORING. Pollution Engineering, September, 1972.

9. Cheney, J. L., and J. B. Homolya, THE DEVELOPMENT OF A SULFUR DIOXIDE CONTINUOUS MONITOR INCORPORATING A PIEZO-ELECTRIC SORPTION DETECTOR, The Science of the Total Environment 5, 69-77 1976.

10. Cheney, Norwood, and Homolya, THE DETECTION OF SULFUR DIOXIDE UTILIZING A PIEZO-ELECTRIC CRYSTAL COATED WITH ETHYLENEDINITRILOTETRAETHANOL, Analytical Letters, 9(4) 361-377, 1976.

11. Cheremisinoff, P. N. and R. A. Young, NEW DEVELOPMENTS IN AIR QUALITY INSTRUMENTATION. Pollution Engineering, 7(2): 24 1975.

12. Connor, W. D., A COMPARISON BETWEEN IN-STACK AND PLUME OPACITY MEASUREMENTS AT OIL-FIRED POWER PLANTS. Presented at the Fourth National Conference on Energy and the Environment, Cincinnati, Ohio, October 4-7, 1976.

13. Conner, William D. MEASUREMENT OF THE OPACITY AND MASS CONCENTRATION OF PARTICULATE EMISSIONS BY TRANSMISSOMETRY, Chemistry and Physics Laboratory, EPA-650/2-74-128 November, 1974.

14. Cross, F. L. Jr., and H. F. Scheff, CONTINUOUS SOURCE MONITORING. Chemical Engineering/Deskbook Issue 125-127 June, 1973.

15. Driscoll, Becker, McCoy, Young, and Ehrenfeld, Walden Research Corp., EVALUATION OF MONITOR METHODS AND INSTRUMENTATION FOR HYDROCARBONS AND CARBON MONOXIDE IN STATIONARY SOURCE EMISSIONS, EPA Contract no. 68-02-0320, EPA-R2-72-106, November, 1972.

16. Elliot, T. C. MONITORING BOILER STACK GASES, Power, 92-94, April, 1975.

17. Ellis, D. H. RELIABILITY OF STACK SAMPLING METHODS VS. CONTINUOUS MONITORING SYSTEMS. Air Pollution Control Association, Pittsburgh, Pennsylvania, Design, Operation and Maintenance of High Efficiency Control Equipment, St. Louis, Mo., 1973 p. 145-147.

18. Environmental Science and Technology, Pollution Control Issue, Vol. 10, no. 11, October, 1976.

19. Fennelly, Paul, F., DEVELOPMENT OF AN IMPLEMENTATION PLAN FOR A CONTINUOUS MONITORING PROGRAM, GCA Corp., March, 1977.

20. Green, M. W., R. L. Chapman, S. C. Creason, R. N. Harvey, G. A. Heyman, and W. R. Pearson, EVALUATION OF MONITORING SYSTEMS FOR POWER PLANT AND SULFUR RECOVERY PLANT EMISSIONS, EPA Contract no. 68-02-1743, Beckman Instruments, Inc., EPA 600/2-76-171, June, 1976.

21. Homolya, CONTINUOUS MONITORING SYSTEMS FOR GASEOUS EMISSIONS, EPRI Workshop Proceedings, Special Report #41, p. 17 October, 1975.

22. Homolya, J. B., COUPLING CONTINUOUS GAS MONITORS TO EMISSIONS SOURCES, Chem Tech, 426-433, July 1, 1974.

23. Homolya, CURRENT TECHNOLOGY FOR CONTINUOUS MONITORING OF GASEOUS EMISSIONS, Journal of the Air Pollution Control Assoc., 25(8) 809-814 August, 1975.

24. Homolya, THE DEVELOPMENTAL NEEDS FOR CONTINUOUS SOURCE MONITORING SYSTEMS OF GASEOUS EMISSIONS, Proceedings of the Fourth National Conference on Energy and the Environment, Cincinnati, Ohio, October 4-7, 1976.

25. James R. E. and C. D. Wolback, QUALITY ASSURANCE OF STATIONARY SOURCE EMISSION MONITORING DATA, Inst. of Electrical and Elcectronics Engineers, Inc., 36, 1976.

26. Jaye, Frederic C., MONITORING INSTRUMENTATION FOR THE MEASUREMENT OF SULFUR DIOXIDE IN STATIONARY SOURCE EMISSIONS. TRW Systems Group, EPA Project 17205 NTIS PB 220202.

27. Journal of the Air Pollution Control Association, Product Guide, Vol. 27, no. 3, March, 1977.

28. Karels, Gale G., Cary R. Kendall, Thomas E. Perardi, and A. Levaggi, USE OF REAL-TIME CONTINUOUS MONITORS IN SOURCE TESTING. Presented at APCA annual meeting June 15-20, 1975. Paper 75-19.5, NTIS PB 230934/AS GPO.

29. Knapp, K. I., NEW TECHNIQUES FOR CONTINUOUS MEASUREMENT OF MASS EMISSIONS, Proceedings of the EPRI Workshop on Sampling, Analysis and Monitoring of Stack Emissions EPRI-41 April, 1976.

30. Lillis and Schueneman, CONTINUOUS EMISSION MONITORING: OBJECTIVES AND REQUIREMENTS, Journal of the Air Pollution Control Association, August, 1975.

31. McRanie, Richard D., John M. Craig, and George O. Layman, EVALUATION OF SAMPLE CONDITIONERS AND CONTINUOUS STACK MONITORS FOR MEASUREMENT OF SO_2, NO_x, AND OPACITY IN FLUE GAS FROM A COAL-FIRED STEAM GENERATOR, Southern Services, Inc., February, 1975.

32. McNulty, K. J., J. F. McCoy, J. H. Becker, J. R. Ehrenfeld, and R. L. Goldsmith, INVESTIGATION OF EXTRACTIVE SAMPLING INTERFACE PARAMETERS, EPA Contract no. 68-02-0742, Walden Research Division of Abcor, Inc., EPA - 650/2-74-089, October, 1974.

33. Woffinden, and Ensor, OPTICAL METHOD FOR MEASURING THE MASS CONCENTRATION OF PARTICULATE EMISSIONS, EPA Contract no. 68-02-1749, Meteorology Research, Inc. EPA-600/2-76-062, March, 1976.

34. Nader, John S., CURRENT TECHNOLOGY FOR CONTINUOUS MONITORING OF PARTICULATE EMISSIONS, Journal of the Air Pollution Control Association, August, 1975, 814-821.

35. Nader, John S., Frederic Jaye, and William Conner, PERFORMANCE SPECIFICATIONS FOR STATIONARY SOURCE MONITORING SYSTEMS FOR GASES AND VISIBLE EMISSIONS. NERC Chemistry and Physic Lab. NTIS PB 209190, January, 1974.

36. Osborne, Michael C.. M. Rodney Midgett, SURVEY OF CONTINUOUS GAS MONITORS TO EMISSIONS SOURCES, Chem Tech, 426-433, July, 1974.

37. Pollution Engineering, Environmental Yearbook and Product Reference Guide, Vol. 9, no. 1, January, 1977.

38. Quick, Durle L., FIELD EVALUATION OF SO_2 MONITORING SYSTEMS APPLIED TO H_2SO_4 PLANT EMISSIONS,, Volumes I & II, EPA Contract no. 68-02-1292, Scott Environmental Technology, EPA-650/2-75-053a (Vol. I) and EPA-650/2-75-0536 (Vol. II), July, 1975.

39. Reisman, E., W. D. Gerber, and N. D. Potter, IN-STACK TRANSMISSOMETER MEASUREMENT OF PARTICULATE OPACITY AND MASS CONCENTRATION, EPA contract #68-02-1229 Philco-Ford Corp., NTIS PB 239864/AS, November, 1974.

40. Scott Environmental Technology, Inc., CONTINUOUS MONITORING OF A COPPER SMELTER ACID PLANT, Phelps Dodge Ajo, Arizona Report no. 73-CUS-2.

41. Scott Environmental Technology, Inc. SUMMARY OF CONTINUOUS MONITORING OPACITY DATA, REFINERY FCC CO BOILER, PHILLIPS PETROLEUM, Avon, California, EPA contract no. 68-02-1400, Report no. 74-CAT-2, March, 1976.

42. Scott Research Laboratories, CONTINUOUS MONITORING OF A COPPER SMELTER DOUBLE CONTACT PROCESS ACID PLANT, EPA Contract no. 68-02-0233, Report no. 73-CUS-2, May, 1974.

43. Shotles, R. S., and J. R. Dallar, CONTINUOUS MEASUREMENT OF SULFUR DIOXIDE EMISSIONS, Mississippi Chemical Corporation, Pascagoula, Mississippi, EPA Report no. 73-SFA-3B.

44. Snyder, Arthur D. Edward C. Eimutis, Michael G. Konicek, Leo P. Parts, and Paul L. Sherman, INSTRUMENTATION FOR THE DETERMINATION OF NITROGEN OXIDES CONTENT OF STATIONARY SOURCE EMISSIONS. NTIS PB 204-877 Vol. 1 PB 209-190 Vol. 2, January, 1972.

45. U. S. Environmental Protection Agency, STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES, Federal Register, 40:46250-46270, October 6, 1975.

46. Roy Weston, Inc., FINAL REPORT ALAN WOOD STEEL COMPANY, CONSHOHOCKEN PENNSYLVANIA, EPA Contract no. 68-02-0240, Report no. 73-BOF-1, December, 1975.

47. Wolf, Philip C., CONTINUOUS STACK GAS MONITORING Part One: ANALYZERS, Pollution Engineering, 32-36 June, 1975.

48. Wolf, Philip C., CONTINUOUS STACK GAS MONITORING Part Two: GAS HANDLING COMPONENTS AND ACCESSORIES, Pollution Engineering, 26-29, July, 1975.

49. Wolf, Philip C., CONTINUOUS STACK GAS MONITORING Part Three: SYSTEMS DESIGN, Pollution Engineering, 36-37, August, 1975.

50. Zegel, W. C., and T. Lachajczyk, THE VALUE OF CONTINUOUS MONITORING TO THE USER, The Journal of the Air Pollution Control Association, Vol. 25, no. 8, 821-823, August, 1975.

Availability of EPA Publications

Copies of United States EPA publications are available free of charge, as long as supplies last, from the EPA library in Research Triangle Park, North Carolina. When supplies are exhausted, one may purchase publications from the United States Government Printing Office or the National Technical Information Service.

U. S. Environmental Protection Agency
Library (MD-35)
Research Triangle Park, N. C. 27711
commercial phone 919-541-2777
FTS phone 629-2779

National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22151
703-321-8543

Superintendent of Documents
Government Printing Office
Washington, D. C. 20402